


Keeping Healthy



THE ROAD TO HEALTH

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Printed in the United States of America

INTRODUCTION

The Road to Health series has several important goals: (1) to show children what good health is, (2) to help children learn how to acquire good health, and (3) to help children learn how to keep their good health.

The Road to Health series concerns itself with the *total* health of children. The concept of total health as expressed in *Health Education,* 1948 edition, jointly produced by the American Medical Association and the National Education Association, includes these four aspects of health: (1) the physical, (2) the mental, (3) the emotional, and (4) the social.

This series—*The Road to Health*—heartily endorses this concept. Each volume in the series sets forth a clear and effective program concerned with physical health. In addition, there is in each book a definite and carefully planned program of games, stunts, and other group activities. The inclusion of this material *as a program* is a unique feature of this series. It is an organic part of the series.

In each volume, though more directly in some than in others, the mental aspects of the child's growth are considered and provided for. In *Your Health and You,* for example, the major part of the instruction material is devoted to the understandable aspects of mental health.

Every book in the series, through its approach to children as participants in group living, contributes specifically and generally to the emotional betterment of children. The group activity material presented in each chapter in each book shows the need for emotional controls and provides opportunity for practice in achieving such controls.

The social aspects of total health become a natural part of any program which is concerned specifically with the mental and emotional aspects of health as well as the physical. When emphasis is laid upon the desirability of the child's success with others—as is the case throughout this series—it follows in a natural way, as such a thing should follow, that the children are led happily toward social competence. Thus *The Road to Health* series makes its important contribution to the welfare of children in terms of their total health.

Full explanations, coupled with demonstrative and explanatory illustrations, lead the pupil to complete understanding of all concepts. The pertinent story material in the lower grades provides easy and interesting opportunities for younger pupils to acquire their basic interest in health information. The series then proceeds from these narrative techniques to a pattern of specific exposition of definite facts. At the end of each chapter in each book a program of review, testing, and suggested activities is presented. In addition to these guides to better learning, each volume contains a glossary of terms simply defined, and an index helpful to pupils.

The authors are happy to acknowledge the critical assistance provided by the American Medical Association and the American Dental Association in regard to both text and illustrations. They wish to give particular thanks to Dr. Charles F. Good, who as consultant gave liberally of his time and professional knowledge.

The authors and publishers feel that in *The Road to Health* series they have provided an honest and helpful guide to pupils on their way to total health.

The Authors

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GOOD FOOD –
FOR GOOD HEALTH
M-W

CHAPTER I

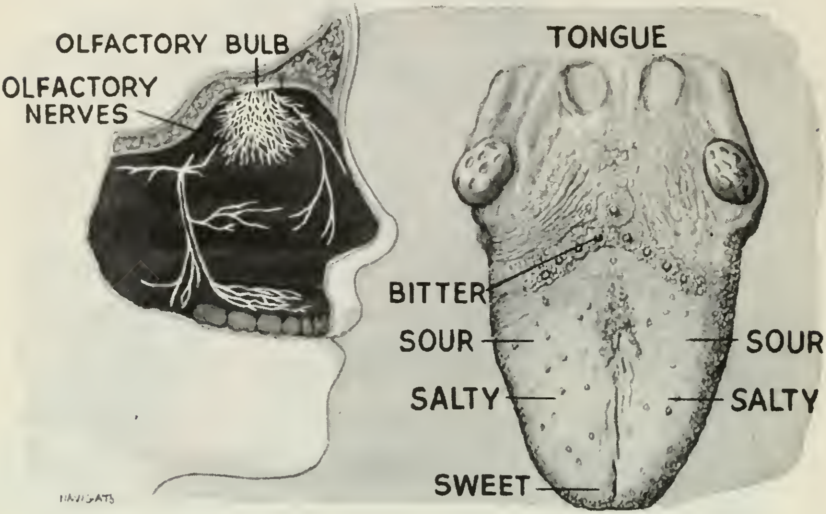
WHY YOU EAT

The Immediate Reasons for Eating

Satisfaction of Hunger. A healthy person usually has a normal appetite. Appetite is a mild, natural longing for food. An appetite may be worked up by sensing the pleasant odors of food. It can be aroused by the sight of foods you like.

When the longing for food is strong, it becomes hunger. Hunger is caused by the contractions of your stomach when it is empty. When you are hungry, you eat, if it is possible to do so. Satisfying your hunger pangs makes you comfortable again. Therefore, you eat to satisfy hunger.

Eating Enjoyment and Taste and Smell. Your senses of taste and smell make eating a pleasure. Whether food tastes good or bad depends upon your own likes or dislikes. But good, wholesome food which is well prepared usually tastes good. A very hungry person may enjoy food that has any kind of flavor or taste.



When you eat food you notice how good it tastes. When food is being cooked you notice certain pleasant odors. That is why you say that the food smells good. The senses of taste and smell are closely associated with appetite.

The sense of taste comes from taste buds located on the tongue, the inside of the cheeks, and the back part of the mouth. These taste buds make it possible for us to distinguish among bitter, sweet, salty, and sour.

The sense of smell comes from a group of nerves located in the upper part of the nose. Here is an example of how these nerves work. Odors are given off from cooking food in the form of vapor or gas. Such odors spread quickly. They sometimes carry long distances. They touch the ends of the nerves mentioned above. Then the nerves carry the sensation of the odor of the food to the brain, and you smell the food.

The chewing of food releases from it certain elements, about which you will learn more in Chapter Three. These elements stimulate the nerve endings in the nose.

Good Eating Habits

Importance of Meals. Good eating habits are important for growth, development, and good health. Eating at regular times is one good habit. Eating proper kinds of food is another good habit. And eating the proper quantities of food is a third good habit. It is important to eat three meals a day. Each meal is important. Plenty of time should be given to each meal. The meal should not be hurried. Eat slowly and take plenty of time to enjoy your meal.

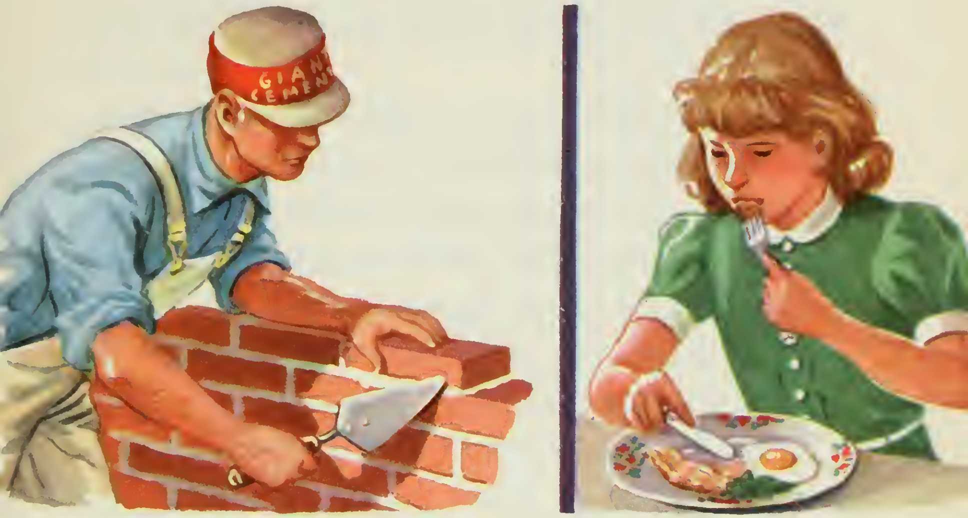
Pleasant Feelings and Relationships. It is important also that your mealtimes be pleasant occasions. Come to the table in a happy frame of mind. Carry on a pleasant conversation at the table. Good conversation during mealtime will do much to prevent one from eating too fast. Avoid quarreling while eating. A good disposition will aid appetite and digestion.

Meals should be eaten in clean surroundings. Attractive eating rooms, free from noise, help to make meals enjoyable.

The Basic Reasons for Eating

Four Basic Reasons for Eating. The four most important reasons for eating are the four needs for food. The first need is for building material. The body needs food to build all its parts. The second need is for material to repair and replace worn-out cells or tissues. The third need is to supply the body with heat and energy. The fourth need is to regulate body functions.

For Building Material. The picture shows two builders, each using different building materials.



The man is building a wall. His materials are bricks. He knows just where to put each brick. He knows which brick to choose for a certain place. He selects his bricks with care. A brick in the wrong place or a poor brick in any place would spoil the wall or building. A good builder uses his material in the right places.

The girl is building a strong body. Her material is the food on the table. These foods contain important elements. The human body is composed of cells. Every living cell is dependent upon food for growth. Cells use the materials in food as the food passes through the body. The cell uses the food for building more cells.

These elements in the foods are the building blocks of tissue, muscle, bones, and teeth. The girl must select the correct foods to maintain the body and build muscle. She must select foods which are a source of new tissue. She must select the correct foods to build her teeth. She must know which are the best materials for her building.

When the man builder uses the wrong brick, it shows immediately. When the girl uses the wrong food, it takes a long time before the body shows the mistake. It also takes some time to correct the mistake. Therefore, it is important that the girl builder should know which materials to use. Learning which are the right foods to eat and then eating them will help the body maintain its health.

For Repair and Replacement. A certain number of the body cells die. When the cells die, they are quickly replaced by others. The cells or tissues wear out and must be replaced. Eating is important for the repair and replacement of cells and tissue. Eating the proper foods will help the body maintain its health. Eating proper foods will replace worn-out parts, and construct new materials in the process of growth.

For Heat and Energy. In the picture coal is being fed to the furnace. The coal will be burned and used up. Heat will result from this process of burning. Such furnaces are used to heat houses and buildings. Houses and buildings are also heated by gas furnaces and fuel oil furnaces. The coal, gas, or fuel oil burning in the furnace makes heat to warm your room. A thermometer in the room will record the temperature. The temperature in the room can be controlled by using less coal, gas, or fuel oil in the furnace.

The boy in the picture is eating food. The food he is eating will be burned and used up. As the

food is burned and used up, it will produce heat in the body. The temperature of the body can also be measured with a thermometer. In this case you use a special kind of thermometer. Unless you are ill, your body temperature always stays close to 98.6 degrees Fahrenheit.

The heat in the body comes from certain kinds of food that you eat, just as the heat from the furnace comes from the coal, gas, or fuel oil. Thus, when the food is burned or used up in your body, it provides heat and energy for you to use in work or play. A person who is starving or fasting does not have energy for work or play. Nor does that person have sufficient body heat. He tends to have lower body temperature. He moves about little and has no desire to be active. Lack of proper food causes a deficiency of the heat and energy needed.

Although the body is like a furnace, it does not burn food in the way a furnace burns coal. When all the coal is burned in the furnace, it no longer gives off heat. The furnace ceases to work. This is not true of the body. Your body is giving off heat at all times, even when you are resting or sleeping. You breathe, your heart beats, and your internal muscles continue to move. As long as you are alive your body is at work. You burn your fuel to support the work which your body is doing. The work of the body is also increased when you exercise and play.

Cold weather also increases the work of the body. You put on heavy clothes to keep out the cold air, but your body is warm anyway. The heat comes from the food you eat. Your house, that is your body, has to be heated all day, every day. It has to be

heated all night, all through the year. In fact, your body has to be heated all the time.

All foods give some energy and heat. However, some kinds of food provide more heat than other kinds. These foods will be discussed later.

For Regulation of Body Functions. Your body depends upon food for a supply of substances which help to regulate body functions. These substances are known as mineral elements. The human body contains minerals in varying amounts. Some of the most important mineral elements found in the human body are given in the table below:

calcium	sulphur	magnesium	copper
phosphorus	sodium	iron	iodine
potassium	chlorine	manganese	

Other substances which help in the regulation of body functions are known as vitamins. Vitamins are also known as the health protecting foods. You will study about them in Chapter Five. There are very minute quantities and traces of other elements. The foods we eat supply these elements. Not every food we eat contains all the elements we need.

Some foods may supply a certain mineral or several minerals. Other foods may not contain these same minerals at all. Minerals exist in varying degrees in different foods. The mineral elements are obtained from a great variety of foods we eat.

The Importance of Minerals. The life of a cell depends upon food. And, unless the food contains minerals, the cell will not grow. All living cells depend on certain minerals like iron and phosphorus for growth, life, and activity. However, all the minerals play an important part in the life and growth of the cells. The mineral elements are found in the muscles, bones, teeth, blood, and all other parts of the body. They enter into the structure of the body. They are highly important for the growth of the cells. They are, however, more important for the regulation of body processes.

Each mineral element has its own special part to play in the regulation of body functions. Minerals control the ability of muscles to contract. Calcium, sodium, and potassium are important in this respect. Minerals control the ability of nerve tissue to do its work. Minerals help us digest our foods. Minerals are also essential to the blood. In fact, as the minerals enter into every living cell, they control all the vital processes.

Minerals are also important for growth and the protection of the body from disease. The regulation of body functions depends on many substances. Besides minerals and vitamins, water and other substances help in the regulation of body functions. Eating a wide variety of foods will help supply a wide variety of substances which are necessary to regulate body functions.

Nutrition. Growth, activity, and freedom from disease all depend upon good nutrition. Nutrition means feeding or supplying the body with food to promote growth and development. Good nutrition is dependent on the kind and amount of food eaten. Eating the right kinds of food will build strong, healthy bodies. Eating the right kinds of food will build keen, alert minds, sound teeth, and strong bones. These factors and many others are important to every person for health and happiness in life

Activities for Health

How to Catch a Ball. Many of your games require throwing and catching. In any case, knowing how to catch a ball is important. You use different

kinds of balls in the games you play. Your skill of throwing and catching is tested as you learn to throw and catch many kinds of balls. It is important to know how to catch a ball.

Watch a person catching a ball. It looks easy. Arms, hands, and fingers are used to catch the ball. The thumbs are spread out from the hand. When the ball comes, there is a place for it. It will be caught in that place. Other parts of the body as well as the hands and arms are used in catching. The elbows and knees are slightly bent. The arms reach for the ball as if giving it an invitation to come. When it comes, the arms draw it toward the body.

If the fingers and hands are stiff and tense, the ball may hit the ends of the fingers. This may cause serious injury to the finger joints. Wrists and arms must be relaxed and not held stiff.

Catching a ball is an important and difficult skill to master. Practice every day is necessary. The pitcher and catcher in a baseball game take a great deal of responsibility. They hold key positions on the team. A key position is one which controls what is taking place. The catcher gives signals to the pitcher. Both pitcher and catcher must be mentally alert at all times for good control.

Bob Feller was one of the pitchers for the Navy during the Second World War. Bob Feller pitched well. All the players on the team knew that he had practiced many years to become one of the best pitchers. When he was a young boy, he spent a great deal of time playing and working outdoors. He began practicing good health habits when he was very young. These early habits gave him strong arms, wrists, and fingers to throw, to bat, and to catch. Good health habits gave him sturdy legs for running and balancing. Good health habits gave him steady eyes to watch the ball. His father encouraged him to take the best care of his body for the big job ahead of him. For five years Bob Feller was at the top of the list of pitchers in the American League in striking out batters on the opposing teams.

Too often a person practices the skill of throwing without practicing the skill of catching. Throwing and catching are the twins of baseball, softball, and many other games related to softball and baseball. Many of your games require you to throw and to catch.

With regular daily practice the skill of throwing will improve. The Greeks in ancient days threw javelins and other objects. Today, you usually relate throwing with catching. Balls of different kinds and sizes are thrown and caught. Boys and girls of different ages may use different kinds and sizes of balls.

Many of you think you know how to throw well. You may not know that there are different ways of throwing. You may not know there is a right and a wrong way to throw. Each type of throw has a special use. There are the overhead throw, the two-hand shoulder throw, and the one-hand shoulder throw. You can practice all three throws. You may discover that you excel in one. If you find one that suits you, it becomes easy for you to prefer to use that one in throwing and catching games.

The Overhead Throw. Tall boys or girls are always popular in games which are played for points or a score. Although a player is not very tall, he may be able to score a point by holding the ball above his head with both hands and throwing it to another from that position. By jumping and throwing, a player may be able to throw the ball high. The ball may be thrown higher than the arms of the tall guards are able to reach. Guards are players whose purpose it is to prevent the ball from reaching another player or a goal or a basket. That kind of throw is called the overhead throw.

To throw a ball from the overhead position you should remember these rules.

Practice often and regularly. Hold the ball securely, high over the head. Balance it with both hands before you throw the ball. Point the fingers wide apart in holding it. Turn the thumbs back in holding the ball. Hold the arms high and almost straight. Bend the elbows slightly. Push the ball forward with the wrists and fingers. Move the hands and arms forward in the direction the ball is to go. Keep the ball high in the air as it travels.

If the player jumps as he throws, the ball will make an arc as it goes from the player who throws it to the catcher. If the ball is caught, the opposing team earns a point or gains an advantage. An advantage is a position favorable to earning a point. The overhead throw is a hard one for opponents to stop or to block.

You throw better and more skillfully as you become stronger. You can control the ball. To control a ball means to direct it to the player or to the position where it will earn a point or an advantage.

Two-hand Shoulder Throw. Another kind of throw is called the two-hand shoulder throw. You probably are eager to learn all the ways to throw a ball. With regular practice, you can find out which is the best for you to use naturally and easily. You have been told how to improve your way of throwing a ball. You are probably eleven years old. Your arms, hands, and fingers have grown large. They have become strong enough to hold, to throw, and to control a ball. To control a ball means that when you throw a ball, it will go where you want it to go. Practicing throwing a ball may be compared with practicing on the piano. If the scales and exercises are practiced carefully and correctly, playing pieces on the piano will be more enjoyable and more interesting. You must practice the skills of throwing. Many games are throwing and catching games. You enjoy the games if you are skillful.

When you practice the two-hand shoulder pass, you hold the ball a little distance above the shoulder. The thumb and the fingers point up and back. The ball is held between the palms of the hands. The hands hold the ball. At the proper time the ball is thrown. The arms swing forward until the elbows are almost straight. The fingers point in the direction the ball is to travel. The weight of the body is changed from the rear foot to the forward foot. You will then find that the ball goes straight. It moves with force and direction. Observing and practicing a few rules about correct ways to throw does not mean less fun but more fun. In games which require throwing the ball to another player, the two-hand shoulder throw probably is the best one to use.

The right way to throw calls for control and judgment. Judgment means thinking about a problem carefully. Strong, steady muscles can move and act with precision as any part of a machine. Your body is like a machine. Machines require care if they are to work smoothly. Proper care of the body requires doing vigorous exercises and eating many kinds of good food.

When you play your games with vigor and enthusiasm, the heart beats faster. You breathe more times in a minute. Your blood flows faster. Your eyes are brighter, your skin is clearer, and your hair looks healthy. You feel, look, and act your best.

The One-hand Shoulder Throw. There are many different movements, particularly those of the arm and shoulder, used in the one-hand shoulder throw.

The ball rests in the right hand just above the shoulder, balanced securely with the left hand. The feet are apart, the left foot placed a little ahead of the right foot. More of the weight of the body rests on the rear foot, the right foot, in this position. (For a left-handed thrower, the technique must be just the opposite.) The hips are turned a little to the right. The elbows are bent and are free from the body.

Now, you are ready to throw. The fingers and the elbow are extended. The wrist snaps forward as the throw is made. The weight of the body is changed to the forward foot, the left foot, and the ball is released with force.

That is the explanation, step by step, of a movement to produce the one-handed shoulder throw.

The discussion, followed by practice, will help you to understand this technique. This type of throw may be practiced in many games and may be used later in basketball. The one-hand shoulder throw is related to the overhand throw used in baseball. Now that you understand the technique of the one-hand shoulder throw you will practice more carefully the skills in the gymnasium and on the playground. First, practice short throws. Gradually increase the distance until you have learned to throw at the distance required for your age with control and accuracy.

Team games are fun. Everyone on a team has something to do. Team members play for the good of the whole team. You play your best for good fun—not to win. If you win fairly, you are happy. If you lose, you know that the other team played better. You can talk about your mistakes. To play your games without becoming tired, you need to get enough sleep every night.

Things to Remember

1. The immediate reasons for eating are satisfaction of hunger and enjoyment.
2. The senses of taste and smell are closely associated with appetite.
3. The sense of taste comes from the taste buds located on the tongue, the cheeks, and back part of the mouth.
4. The sense of smell comes from a group of nerves located in the upper part of the nose.
5. The four basic needs for food are for building material, for repair and replacement, for heat and energy, and for regulation of body functions.
6. Eating at regular times is a good eating habit.
7. Eating the proper kinds of food and eating the proper quantities of food are good eating habits.
8. The human body is composed of cells and the cells are dependent upon food for growth.
9. Minerals play an important role in the control of all the vital processes of the body.
10. If your bodies are strong and healthy, you can play games or practice skills for a longer time without becoming tired.

Study Exercises and Questions

1. Where are the taste buds located?
2. Why is it important to eat three meals a day?
3. What kinds of materials are used to build a house?
4. What kind of material is used to build your body?
5. (a) What kind of fuel is used to heat your home? (b) What other kinds of fuel are used to heat homes?

6. What is the normal temperature of your body?

7. How do you take a person's temperature? Ask your mother or father to let you try it. Be prepared to tell about your experience.

8. What effect does cold weather have upon your body?

9. Have you ever seen a living cell under a microscope? If not, ask your science teacher to show you one. Be ready to tell about it if your teacher asks you.

10. Write the names of some of the most important minerals in your body and tell where they come from.

11. What part do the minerals play in your bodies?

12. Give the four basic reasons why you eat.

Suggested Activities

1. Make a chart of good eating habits. Allow spaces on your chart for each day of an entire week or month. Then check your own good eating habits for those days and make the record on your chart.

2. Make a list of games that require you to throw and catch. The names of many of these games suggest clues for playing them. A clue is a guide. Name as many clues as are suggested to you by the games you have listed.

Words to Master

contractions	basic	elements	opponents
relationships	calcium	regulation	functions


SOURCES OF FOOD

CHAPTER II

WHERE FOOD COMES FROM

Classes and Sources of Foods

Meat, Poultry, and Fish. Your food comes from many places. All food which man eats comes from two sources. Food comes from plants or food comes from animals. A food that comes from animals is called meat. You eat many different kinds of meat. For example, beef comes from cattle, veal comes from calves, pork comes from pigs, lamb and mutton come from sheep. You eat poultry, such as chickens, turkeys, ducks, and geese. Chickens also supply you with eggs. Cows supply you with milk, and from milk, butter and cheese are made. You eat many kinds of fish that are caught in various parts of the world.

Fruits, Vegetables, and Grains. You also eat many different kinds of fruits and vegetables. You eat bread, rolls, and cereals. The grains—wheat, rice, rye, corn, oats, and barley—come from the seeds of grasses. They are important sources of food.

Where Foods Are Grown. A great variety of foods is available throughout the world. The kinds of food grown in a locality depend upon the climate, the nature of the soil, and other factors. For example, rice is grown in moist, tropical or semitropical climates, like that of the Orient. Oranges and grapefruit are grown in California, Florida, and the Southwest. Modern methods of transportation and refrigeration make it possible to ship foods all over the world. Therefore, many varieties of foods are available to you from all parts of the country and the world.

Foods from Plants

Natural Plant Foods. Some plants which can be used directly as food without being changed in any way are tomatoes, celery, beets, lettuce, oranges, and apples. They may be eaten unchanged. You may eat each in its natural state because it is a natural plant food.

Prepared Plant Foods. Some plant foods are changed to what is called a *prepared food.* Cornflakes is a prepared food which is made from corn.

The corn goes through many processes and much preparation before it comes to your breakfast table as cornflakes.

Oatmeal is another prepared food. It is not a natural food. You do not eat the oats in the form in which they grow. Something has to be done to them before they can be eaten. In preparing oats for human use, special milling operations are used to remove the hulls.

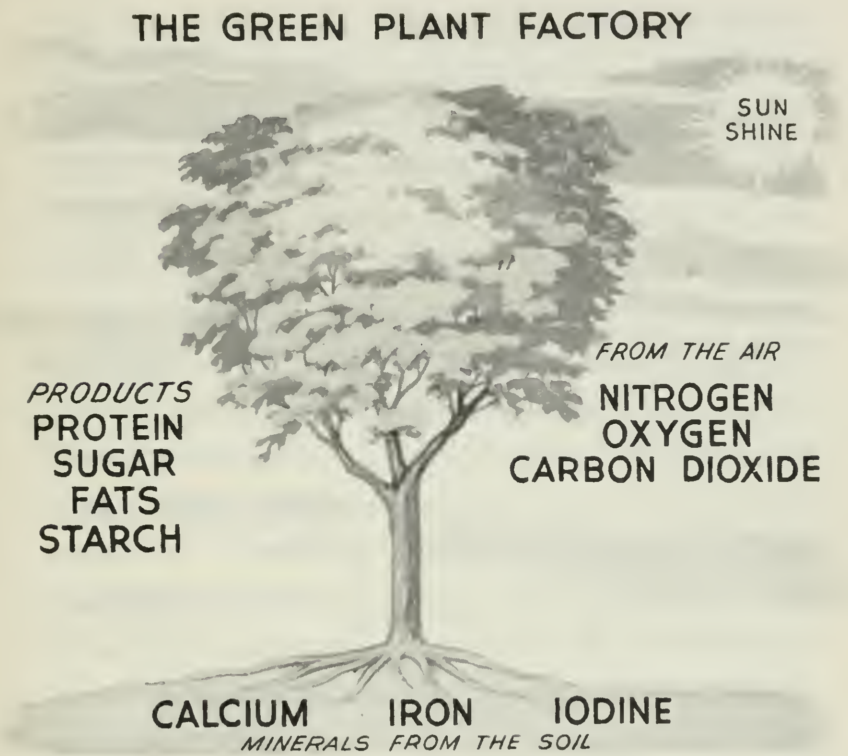
The Parts of Plants Used for Food. A plant has a number of different parts. Some of the different parts of a plant are used as vegetables. These parts are the roots and tubers, stalks or stems, leaves, flowers, seeds, or seed pods, and fruits.

This picture shows many of the parts of the plants you eat. Some plants whose roots and tubers

you eat are potatoes, carrots, beets, and turnips. Some plants whose stalks or stems you eat are celery and asparagus. Some plants whose green leaves you eat are spinach and lettuce. Cauliflower and broccoli are plants whose flowers you eat. Plants whose seeds or seed pods you eat are peas and beans. Berries and apples are plants whose fruit you eat. These are only a few examples of the parts of the plants used for food. You probably could name many more.

How Plants Produce Food. The plants obtain their food or the elements from which they make food from the soil. As a plant grows, it takes simple substances from the soil and water. Then with the aid of air and sunlight the plant changes these simple elements into complex substances. These complex substances are sugar, starches, fats, and proteins. These are elements which are needed for food by animals and human beings also. Later you will learn about these basic elements and what they do for your body.

You will now learn in more detail where the plants get their food and how they make food for you. Plants get minerals and water from the soil.



These minerals are dissolved by the water in the soil and the plants use them for their food.

The tree represents all green plants which grow in the soil. Three important minerals in the soil are iodine, iron, and calcium. Calcium is the scientific name for lime. In addition to iodine, iron, and calcium, most soils contain phosphorus, potassium, sulphur, sodium, magnesium, and traces of other minerals. In Chapter Four you will learn more about these minerals and how they help regulate body processes. These are the minerals that plants use for their own food.

The chart calls the plant a factory. In other words, the plant makes something. Plants take minerals and water from the soil. The air around the plants contains oxygen, carbon dioxide, and nitrogen. The plants take sunshine and carbon dioxide out of the air and from those things make sugar, starch, fats, and protein for us to use.

For example, think about a potato plant growing in the field. The potato plant takes sunshine and carbon dioxide out of the air. It also takes minerals and water from the soil. But more important than that, the potato plant is manufacturing potatoes all summer long for someone to dig in the fall. An important food element is made by the plant and stored in the potato. The plant makes starch and stores it in its tubers, the part of the potato plant which you eat.

Corn is another very useful plant. As it grows all day, the corn plant takes from the soil materials for making sugar, starch, and fats. Three different kinds of food which you buy at the store that were made from the corn plant are corn syrup, cornstarch, and corn oil. The sugar, starch, and oils of which these are composed were first made by the corn plant.

All day long green plants are working to make and store in their parts the food elements your bodies need for growth, heat, energy, and protection. However, plants make only small amounts of protein. They do not make enough to supply all the protein material that humans need. Cows can eat enough of the green plants to supply sufficient protein, but growing human beings cannot. Therefore, you have to turn to animal sources of food for sufficient protein.

Foods from Animals

How Animals Produce Food. Animals obtain their food from plants. One of the animals which is the source of much of your food is the cow. The cow eats all day long the little green plants growing in the meadow. While she eats, she, too, like the

plants, is manufacturing food elements that you are going to use. The cow furnishes you with milk which you use for food. Milk contains much protein in addition to fat, sugar, mineral salts, and water. Milk is an important food in its natural state. Milk is also used to make butter and cheese, two important prepared foods. The dairy cow is, therefore, a very important animal. Here are some facts that prove the cow is important to you. An average cow will produce about 7,600 pounds of milk a year. A quart of milk weighs approximately two pounds. This means an average cow produces about 3,800 quarts of milk a year.

The egg is another important food produced by animals. The eggs of poultry, and of some wild birds, as well as the eggs of some fishes, are used for food. Eggs are a rich source of protein. They also contain fat, and important minerals and vitamins.

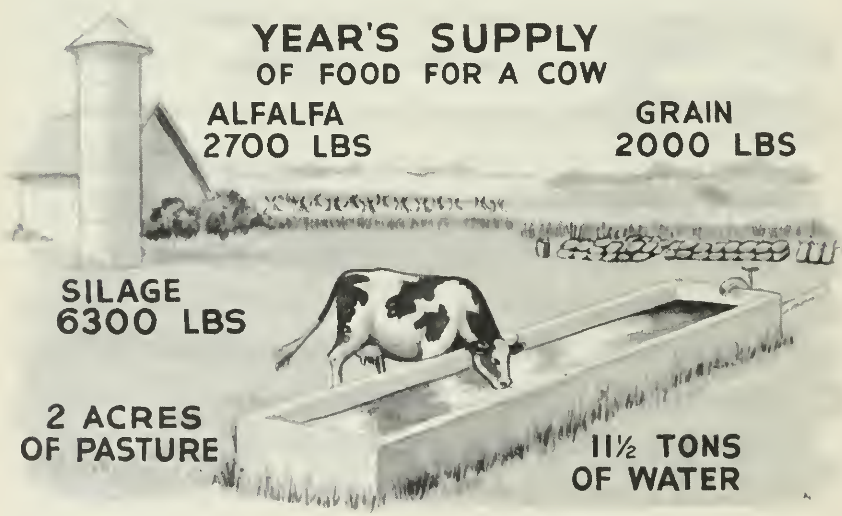
What the Cow Eats. A cow needs food to keep her well and healthy and to help her supply milk for you. Dairy cows eat two different types of food. They eat summer food in the pasture, and winter foods which are fed to them in the barn. Some of the winter food is called *silage.* Silage, which is usually corn fodder preserved in a silo, is a very important winter food for the cow. Silage takes the place of the green plants the cow eats in the summer.

One of the foods that the cow may eat is alfalfa. Alfalfa is a green forage plant. It supplies the same food element for the cow that meat and eggs supply for you. That is protein. Alfalfa hay, then, is the cow's meat and eggs. Alfalfa hay is one food which helps the cow put protein into the milk you drink. Other kinds of hay are also fed to cows.

In addition to silage and hay, the cow eats grain. Grain is a cereal to the cow. It is the cow's bread and oatmeal. When you eat a breakfast cereal, it gives you heat and energy. The grain the cow eats gives her energy too. These three foods, silage, alfalfa and other hay, and grains, are the winter food of the cow.

A cow is a very busy animal in the summer time. She eats steadily all day long for about five months. It takes two acres of pasture to feed an average cow. A cow drinks four to six gallons of water a day.

A cow eats a large amount of food during the summer and winter. It is difficult to imagine the total amount of a year's supply. To produce 3,800



quarts of milk per year, a cow needs all the food you see in the picture. The amounts of protein, fats, carbohydrates, minerals, and vitamins contained in each plant a cow eats are very small. That is why the cow has to eat such large amounts of plant food. She must eat such amounts of plants as will secure enough of the food elements for her own body and to store in her milk for you to use.

How Meat Is Produced. In the summer, cattle roam and graze on the large western plains. The winter food of these cattle is silage, hay, and grains just the same as for the dairy cow. No matter what the season of the year, all the food these cattle eat is converted or changed into muscle-building protein for you to eat. You will learn more about muscle-building protein in Chapter Four.

Both beef and dairy cattle eat the same food. One makes muscle-building meat for you. The other makes milk. These two animals manufacture the same food element for you, protein. The beef cattle store it in meat. The dairy cattle store the protein in milk.

Meat markets and slaughterhouses have large refrigerators for storing meat. Whole sides of beef

hang in these refrigerators. The sides of beef are used for food.

Meat comes from other animals than cattle, also. Besides pork, mutton, and lamb, man eats certain wild animals called game. These animals include the rabbit, squirrel, deer, bear, and many others.

The flesh of poultry is also meat. There are many game birds that are eaten as meat, too. Some examples of these are wild duck, quail, and pheasant.

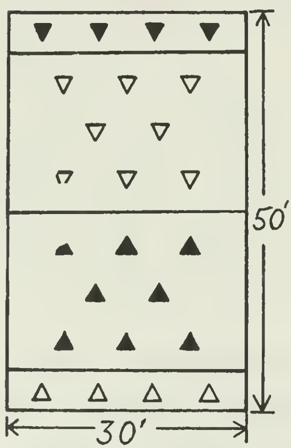
Another kind of meat is the flesh of fish and shellfish. Fish is an important food.

Natural Meat Foods. The meat or flesh food may be eaten unchanged, except for changes that take place during cooking. Proper cooking of the food is important. It makes the food more easily digested and gives it a good taste. The flesh foods or meat furnish you with protein as well as other elements your body needs.

Prepared Meat Foods. Some natural flesh foods may be eaten after they have been changed. Examples of this are ham, bacon, corned beef, and frankfurters. Ham and bacon are parts of pork which have been processed with smoke. Corned beef is beef that has gone through a special process of preparation. Frankfurters are made of beef or pork sausage stuffed into links of skin. The pork comes from pigs and the beef comes from cattle. The pork has been changed to ham, bacon, and frankfurters. The beef has been changed to corned beef and frankfurters. In these instances you eat meat that has been changed.

Summary of Sources of Food Elements. Plants take minerals and water from the soil, sunshine and carbon dioxide from the air, and from these simple things make sugar, starch, fat, protein, minerals, and vitamins. These food elements are then stored in the plants. The purpose of the green plant in this world is to make food for human beings and other animals. But the amount of protein manufactured by plants is small. Man, therefore, has to depend upon other sources for his necessary supply of the element protein. There are animals who can eat enough plants to supply protein for themselves and for human beings, too. For that reason the meat of these animals is used to supply protein for human beings.

Activities for Health



End Ball. A large number of boys and girls can play the interesting and vigorous game of End Ball. You will need to become acquainted with the plan of the game. You will need to know about the players who make up the two teams. You will need to know their duties and their responsibilities.

End Ball is a team game. This means that there is some competition. It must be the kind of competition that encourages everyone on the team to play his best and to play fairly. A team game also suggests that there are an even number of players on each team. These players all have responsibilities. Whatever the player's job is, it is important for the team that it be done well.

The playing space is a large area almost square. It should be divided in the center into two even sections called courts. The six feet at the end of each court is the territory for the end men or base men. The players are called guards and end men. The end men stand in the space at the end of the court. The remaining players are guards. The guards stand facing the end men.

A net is stretched across the center of the playing space. The net should be six feet from the floor or the ground. A rope stretched between two trees is a good substitute if a net is not available. The game can be played without a rope or net if necessary. Both teams will then agree upon a center division of the space used in the gymnasium, on the playground, or in the backyard.

The playing space or court may be as large or as small as the two teams choose or agree upon. The size of the court should be determined by the skill of the players. The skills in this game are throwing, catching, and passing the ball. You are probably ten or eleven years old. You should be able to throw from forty to fifty feet. You will need a ball light enough to throw high and far, and large enough to catch.

The guards in the guarding section are placed farthest away from their own base men or end men. Guards face their own end men. The guards are required to throw high over the heads of the guards of the opposite team to their own end men. One of the end men must catch the ball. If he catches the ball, one point is scored. If he does not catch the ball, it is thrown to the opposing guards. Then they have a chance to throw to their end men. The playing continues. The ball is thrown back from end men to guards, and from guards to end men.

Each team chooses a captain. The captain must be able to throw well and to help you become better team players. The captains learn to manage the game.

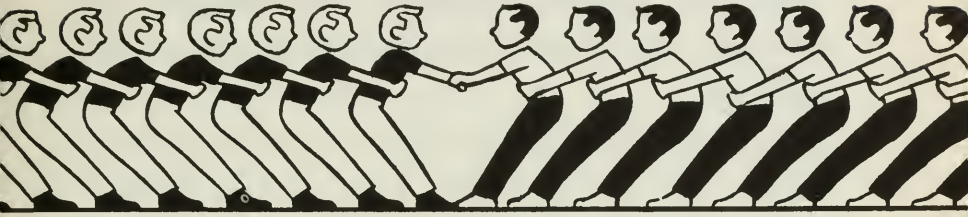
There are mistakes to avoid. You are not allowed to step over the lines which divide any of the sections of the court. You are not permitted to walk or run with the ball in your hands.

If you violate these rules, the game becomes slow. Then there is no fun in the game. If the ball is passed fast, everyone gets a turn. You may pass the ball to another teammate if you feel you cannot throw it successfully to earn a point.

Throwing requires good control of muscles. It requires strength in the arms and shoulder muscles. Proper food and plenty of rest help your muscles become strong. They help you to grow taller and stronger. The tall boys and girls are good guards because they can block the ball. The tall end players are good catchers. They can reach higher. Reaching and stretching helps to make your back, shoulder, and arm muscles strong.

Human Tug of War. Vigorous activity helps to condition the body to resist disease. One type of activity is a contest to test your strength. Tug of War is a contest of strength in which the teams pull in opposite directions. Because it is a pulling contest, you might think you are having your arm strength tested. Before you have finished, you will have discovered that you had to use your back, leg, and arm muscles. In fact, all the big muscles of your body are called upon to pull vigorously.

In Tug of War you divide the players into two teams and one extra player. The teams face each other. Each team is arranged in single file. A file is a line. One player stands behind the other to form a line. The teams stand on opposite sides of a line drawn on the floor of the playroom or on the ground out of doors. Each player grasps tightly the waist of the person in front of him. The team captain



stands first in each line. The captains join hands firmly.

The extra player directs the contest. He is the leader for the contest. He gives the signal to start the pull. Each team tries to pull the other team over the center line.

Before you start to pull, you look like a heavy chain with each team player a part of the chain. You are a link in the chain. The strongest team wins the contest. To pull the other team across the center line is the object of the contest.

Usually you play three out of five contests. If one link in the chain breaks, the other team wins. Breaking a link means that one player in the line was not strong enough to hold his grasp. It is hard work, but it is fun.

After the contest is over, you may wish to talk about some of the good points. At first, perhaps you thought it was going to be easy to pull and win.

Then you discovered that to win, strength, endurance, and balance as well as teamwork are necessary.

Remember the health rules. To be strong your bodies need enough of the proper kind of foods. Sometimes you are in a hurry in the morning. You do not take time to eat a good breakfast. It is important that you eat a good breakfast since it gives you a start for the day's work. It takes energy, strength, and endurance to play vigorous games. Food, sleep, and play help to supply those qualities. You have learned that happy, healthy boys and girls are the best players on the team. They are willing to work together for the good of the team.

Tug of War. The contest described above is called Human Tug of War because you had players in the chain. There is another way to play Tug of War. It is fun to know more than one way. Instead of having players be the tug, a clean, smooth rope is pulled. It can be ¾ inches thick.

A narrow piece of material is tied in the center of the rope. If it is white or red it can be seen by everyone. Each team chooses a color. The team color is tied on the rope a few inches ahead of the place where the first player of each team stands. This color mark chosen for each team should be placed about fifteen inches from the center mark.

When the signal is given to start pulling, the players on each team pull on the rope for about thirty seconds. At the end of that time the team which has pulled the rope toward its side of the line wins.

Either kind of contest requires arm, shoulder, and leg strength. Of course, players are needed whether a rope is pulled or whether boys and girls represent the tug.

If players are pulled, the contest is called Human Tug of War. If a rope is pulled, the name of the contest is Tug of War. It is fun to know two ways. Safety demands that you pull with your entire body. You must be careful not to jerk your arms and shoulders. It is a fair and an interesting contest if all the rules are observed.

Things to Remember

1. All food which man eats comes from plants and animals.
2. Natural plant foods are parts of plants that can be eaten raw or with no change other than cooking.
3. Natural animal foods need no other processing or preparation than cooking.
4. Prepared foods are those which have to be put through special processes to prepare them to be eaten.
5. Proteins, sugar, starches, fats, minerals, water, and vitamins are elements of food.
6. Plants take minerals and water from the soil.
7. Plants take sunshine and carbon dioxide from the air.
8. Plants make protein, sugar, starch, fat, minerals, and vitamins from the food elements they take from the air and soil.
9. Milk contains much protein plus fat, sugar, mineral salts, and water.
10. Plants and animals furnish the food elements needed for growth, for repair and replacement, for heat and energy, and for regulating body functions.

Study Exercises and Questions

1. Make a list of foods that come from plants.
2. Make a list of foods that come from animals.
3. Give the names of two plants besides those listed in the text whose roots we eat.
4. Name two plants not given as examples whose stalks or stems we eat.
5. Name four plants whose leaves we eat.

6. Name four plants whose seeds we eat.

7. (a) What food elements do plants get from the soil? (b) What elements do they get from the air?

8. What is meant by the green plant factory?

9. (a) What are the names of the winter food a cow eats? (b) What elements does the cow get from these foods?

10. (a) What food does the cow eat in the summer? (b) What elements does the food supply?

11. Give two examples of prepared plant foods.

12. Give two examples of prepared animal foods.

Suggested Activities

1. Perhaps your teacher will permit your class to plan a trip to a wholesale vegetable market. Be sure to note the many kinds of vegetables that are probably grown in different parts of the country.

2. Draw plans for vegetable market displays for your locality for summer and autumn. If an old seed catalog is available, you could paste pictures of each vegetable and fruit in the spaces in bins or upon tables. Otherwise, write the names in the spaces. Be sure to include all the vegetables and fruits grown in your locality. And be sure that you don't put early summer vegetables among the late fall vegetables.

3. Draw plans for display cases in a meat market. Name all the different kinds of meat that you might expect to find in a meat market in your town.

Words to Master

protein	minerals	refrigeration	nitrogen
carbohydrates	vitamins	carbon dioxide	oxygen


THERE IS A GREAT
VARIETY OF GOOD FOODS

CHAPTER III

FOODS AND THEIR BASIC ELEMENTS

What Foods Are

The Basic Needs of the Body. Your bodies are made of many kinds of material which must be supplied in the food you eat. Therefore, you need to provide your body with a variety of foods for health. You must have foods for building material and growth. You must have foods that supply material for repair and replacement of worn-out tissue. You must have foods that supply materials for heat and energy. Finally, you must have foods to keep your bodies in good running order.

An individual food may perform any one of these functions. Or, an individual food might perform all of the functions. It is important that the foods you eat do perform all the functions to maintain the body in health. You can get all the right kinds of food needed for health by using the basic seven food groups for a guide.

The Basic Elements. The basic seven food groups were developed by the government during the Second World War. The foods in these basic food groups will provide you with basic elements. The basic elements contained in foods make you grow, repair and replace tissue, provide heat and energy, and regulate body functions. Working men and women need the basic food elements. Growing boys and girls need basic food elements. In fact, everyone needs the basic food elements for good health.

Foods within each of the basic seven food groups are much alike in food value. All the food groups contain basic elements. Before you learn more about the basic elements, however, you will learn something about each food group.

The Basic Seven Food Groups

Group One. This basic food group consists of leafy, green, and yellow vegetables—raw, cooked, frozen, or canned.

Asparagus, green
Beans, green
Broccoli
Brussels sprouts
Cabbage, green
Celery, green
Chard
Collards
Endive, green
Escarole
Kale
Lettuce, leaf
Mustard greens
Okra
Peas, green
Peppers, green and red
Spinach
Turnip greens
Wild greens
Other greens
Beans, wax
Carrots
Pumpkins
Squash, winter yellow
Sweet potatoes
Turnips, yellow
Yams

Group Two. Citrus fruit, tomatoes, and raw cabbage make up the second basic group of foods.

Grapefruit
Grapefruit juice
Kumquats
Lemons
Limes
Oranges
Orange juice
Tangerines
Tomatoes
Tomato juice
Brussels sprouts
Cabbage, raw
Cauliflower
Greens, salad
Kohlrabi
Peppers, green, raw
Rutabagas
Turnips, raw
Cantaloupes
Pineapples
Strawberries, raw

Group Three. Potatoes and other vegetables and fruit—raw, cooked, frozen, canned, or dried—are the third group.

Potatoes
Sweet potatoes
Artichokes
Beans
Beets
Cabbage, white
Cauliflower
Celery
Cucumbers
Eggplant
Leeks
Lettuce, head
Mushrooms
Onions
Parsnips
Radishes
Rutabagas
Salsify, or oysterplant
Sauerkraut
Squash, summer
Sweet corn
Turnips
Apples
Apricots
Avocados
Bananas
Berries
Cherries
Cranberries
Currants
Dates
Figs
Grapes
Peaches
Pears
Persimmons
Pineapple, canned
Pineapple juice, canned
Plums
Prunes
Raisins
Rhubarb
Watermelons

Also, vegetables and fruits not listed elsewhere.

Group Four. Milk, cheese, ice cream.

Milk, whole, skimmed, evaporated, condensed, dried

Buttermilk

Cheese, soft, hard, or processed, such as cream cheese and cottage cheese, cheddar cheese, or pimento cheese

Ice cream

Group Five. Meat, poultry, fresh eggs, dried beans and peas, nuts—fresh, canned or cured.

Beef
Veal
Mutton
Lamb
Pork (except bacon and fat back)
Lunch meats
Eggs
Dried beans
Dried peas
Lentils
Soybeans

Variety meats, such as liver, heart, kidney, brains, tongue, sweetbreads
Poultry: chicken, duck, goose, turkey
Fish and shellfish
Soya flour and grits
Peanuts
Peanut butter
Nuts of all kinds

Group Six. Bread, flour, and cereals—whole-grain, enriched or restored.

Breads:
- Whole-wheat
- Dark rye
- Enriched
- Rolls or biscuits made with whole-wheat or enriched flour
- Oatmeal bread

Crackers:
- Enriched
- Whole grain
- Soya

Flour:
- Enriched
- Whole-wheat
- Other whole-grain

Corn meal, whole-grain or enriched

Grits, enriched

Cereals:
- Whole-wheat
- Rolled oats
- Brown rice
- Converted rice

Other cereals, if whole-grain or restored

Group Seven. Butter and fortified margarine.

The basic seven foods give energy and protect health. The foods listed below give chiefly energy.

They may be eaten in addition to the basic seven foods, but not in place of them.

Energy Foods

Bacon
Drippings
Lard, other shortenings
Mutton fat
Poultry fat
Salad dressings
Salad oils
Salt pork, fat back
Suet

Honey
Jams
Jellies
Molasses
Preserves
Sirup
Sorghum

Corn meal, degerminated
Cornstarch

Hominy grits
Macaroni
Noodles
Rice, white
Spaghetti

Unenriched:
- Crackers
- White bread, rolls
- White flour

Cakes
Candy
Chocolate
Cocoa
Cookies
Pastries
Sugar
Other sweets

Basic Elements in Foods

Mixtures of Basic Elements. All foods are mixtures of basic elements. Some foods may have more of one element or another, but the elements are there mixed together. There is no one food, however, which contains all the elements in proper amounts to keep people alive. It is necessary to eat many different foods to supply all the needs of the body. The guide to good eating is the chart of the basic seven food groups.

What the Basic Elements Are. The basic seven food groups provide you with the basic elements.

There are six basic elements provided in foods, which are necessary to the body. These basic elements are:

Carbohydrates	Proteins
Fats	Vitamins
Minerals	Water

You may wonder why water is included in this list. Water has no food value but it is present in practically all foods. About three fourths of your body weight is water. Water is vital to every living thing. You could not live very long without water. It is important for the regulation of body functions.

The word *element* means *a part*—especially a part that cannot be separated or made out except by a chemical analysis. For example, analysis shows that the parts or elements of milk are water, protein, carbohydrates, fat, minerals, and vitamins. The elements are the simplest parts of substances.

All foods have many elements or parts in them. The seven basic food groups contain many foods which have large amounts of the same element or part. To find out what elements or parts are to be found in the food groups is your purpose.

Protein. Basic food group five has meat listed as one of the important foods. The muscles of all animals are composed of an important element which you use for food. You might call it the muscle-building element. The scientific name for this element is *protein.* It is the protein in the meat which makes strong muscles in girls and boys. It is the protein in meat which makes strong muscles in women and men. In fact, protein is the element in meat which makes strong muscles in any animal.

There are many other foods that have protein in them. Group four contains milk and cheese which are also good sources of protein. Many of the foods listed in the seven food groups have protein.

However, meat is the best source of protein. Remember, one of the reasons you eat is to supply building material to your body. The protein you eat in your foods builds new cells. The protein is the source of new tissue. The protein helps you grow.

Carbohydrates. Basic food group six consists of bread, flour, and cereals. Each of the foods listed in this group is made from one of the cereal grains. The cereal grains are wheat, corn, oats, rice, barley, and rye. Any food made from a grain has starch in it. Therefore, breads, crackers, toast, and cereals all have starch in them.

The list of energy foods contains candy, chocolate, cocoa, cakes, sugar, pastries, and other sweets. These are foods which contain sugar. Foods with parts or elements of starch or sugar are very closely related. The scientific name for foods containing starch or sugar is *carbohydrate*. Thus starches and sugars are known as carbohydrate foods. You remember, another reason for eating is to furnish heat and energy to the body. Carbohydrates give heat and energy to the body. Many foods in the basic seven food groups give energy and protect your health.

Fats and Oils. Group seven of the basic food groups consists of butter and fortified margarine. These are fat foods. Many of the energy foods contain fats and oils. Butter is made from cow's milk. Butter can also be made from goat's milk. Most of the fats are of animal origin. Bacon, salt pork, lard, beef, suet, mutton, tallow, duck and goose grease, and fish oils are examples. Fats come from some vegetables. Vegetable fat is contained in the fruits and seeds of a few plants. Examples of this are cocoanut oil, cottonseed oil, olive oil, and peanut oil. You use these oils in your salad dressings. Therefore, salad dressings contain fat.

The yolk of an egg also contains fat. Cheese made from whole milk has a large amount of fat. Margarine is made by churning a mixture of fats with milk. Some butter may be added to the milk when churning. Oleomargarine is a mixture of vegetable oils and animal fats. Nut margarine is made entirely from vegetable oils.

Fats also play an important role in furnishing the body with heat and energy. Fats and oils help flavor your food and make it taste better. Fats and oils are found in practically all basic seven foods.

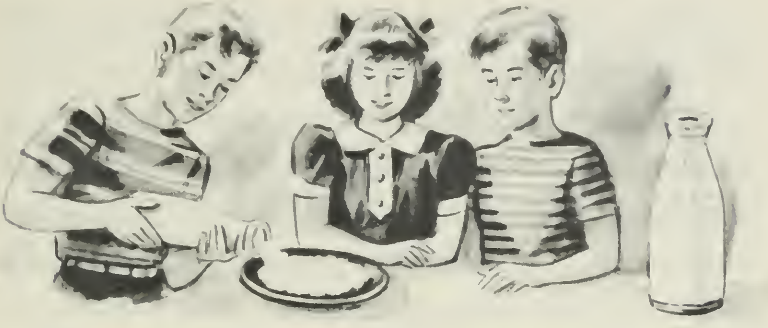
Groups one, two, and three of the basic seven food groups consist of fruits and vegetables. It has been stated that foods in all food groups contain a mixture of basic elements. It has also been said that proteins, carbohydrates, fats, and oils are found in all food groups. You will remember, too, that these elements are present in varying amounts. Fruits and vegetables furnish small amounts of carbohydrates and fats and protein. However, the chief value of fruits and vegetables in the diet is to supply the body with other important elements. These elements are called minerals and vitamins.

Minerals and Vitamins. The minerals supplied by fruits and vegetables were named in Chapter One. They are calcium, phosphorus, sulphur, sodium, chlorine, magnesium, iron manganese, copper, iodine, and traces of others. Minerals, you recall, help regulate body functions. Thus you depend on fruits and vegetables for this important function. More will be said about minerals and the important role they play in the body in the next chapter.

Foods, that is meats, fruits, and vegetables, contain minute quantities of elements which are called vitamins. Like minerals, they too are body regulators. Vitamins are needed in very small amounts to maintain the health of your body.

The Food Elements in Milk. Each of you has probably at some time noticed a bottle of sweet milk that has been standing in the ice box or refrigerator. Maybe you noticed that all the milk in the bottle did not look the same. You probably noticed there was a difference in the upper part of the bottle. That was the cream which had come to the top. Cream is a fat food. It belongs to the foods listed in Group Four of the basic seven food groups. Milk is one food in which we can easily see one of the parts or elements, the fat.

In homogenized milk it is not possible to see the fat. Milk contains many millions of fat particles. The larger fat particles can be broken into smaller ones by mechanical treatment. When this is done, the smaller fat particles will not rise so easily to the top of the milk bottle. The color of the milk still looks the same. Homogenized milk has been given this mechanical treatment. The cream will not come to the top of the bottle after the milk has been homogenized.



The next time you have an opportunity, examine a bottle of sour milk closely. You will notice there seem to be parts floating around in a watery substance. These lumpy parts are the protein part of the milk. The watery part of the milk is called whey. The whey is really water with milk, sugar, and minerals dissolved in it. Scientists have experimented and discovered that vitamins also are present in milk.

The Basic Elements of Potatoes. One element that you can see and feel in a potato is water. The potato also contains considerable starch. Although this element cannot be seen, you can prove that there is starch in potatoes. Scientists know by experiments that a drop of iodine put on any substance containing starch will turn that substance a deep blue color. If you put a drop of iodine on a thin slice of potato, you will note the dark spot that will appear on the potato. The spot may look black to you. That is because there is so much starch in a potato. Later on you may be able to see the dark blue color. Thus you can prove that the potato has starch in it. In addition to starch and water, the potato also has protein, minerals, and vitamins in very small amounts. However, there is neither sugar nor fat in potatoes.

The Basic Elements of Meat. The next time your mother prepares meat for the table look carefully at the meat. There are two distinct parts to the meat, the lean and the fat. The lean meat is the muscle of the animal. This muscle part contains the protein element. You may notice the lines and streaks running through the meat. These lines and streaks show the structure of the lean and the fat of the meat. There is moisture or water in meat, too. You can feel the moisture on raw meat. There are also minerals and vitamins in meat even though you cannot see them. Meat has no carbohydrates in it.

The Basic Elements of Peanuts. You can tell quite easily one food element contained in a peanut.

Peanuts make grease spots on the paper bags in which you carry them. The element in foods that makes a grease spot is fat. Therefore, peanuts have fat in them. The other elements or parts peanuts contain are protein, carbohydrates, minerals, and vitamins.

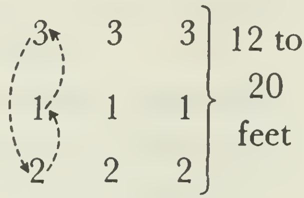
Activity for Health

Ten Trips. This is a game which can be played in a small space if necessary or a larger space if it is available. The more space you have for your games, the more freedom there is for your body movements. Your body movements are better if they are free and vigorous. However, you should not allow the lack of a large playing space to prevent you from playing your games. It is well to learn the games and practice them in a small space. Then, when you have more space, you are familiar with the game and are ready to play.

Ten Trips is a traveling game. A ball or beanbag travels and makes ten complete trips. You may have guessed that Ten Trips is a race. A racing game is always exciting. It must be played according to rules. To follow rules you must keep from becoming too excited.

There should be at least six players, but there may be nine, twelve, fifteen, or more. Divide the players into teams of three players each. The members of each team take the numbers one, two, and three.

By the arrows in the picture you will see that these three players are arranged in a line. The picture shows three teams, but if there are many players, you could have seven or eight teams.



The space between each two players can be six to ten feet. The distance is determined by how well you can throw. The ones stand between the twos and threes. They start the trips. A ball or a beanbag may be used to do the traveling. All teams should use balls or beanbags the same size. A six-inch square beanbag is a good size to use.

Now you are ready to go. A fair race requires starting when a signal is given. All numbers one in each line start the trips. Or, a leader may start the game. Every one must start at the same time. You are expected to know which kind of throw is best for you. You have read about the different kinds of throws in Chapter One. The leader says, "Go." The ball or beanbag starts its trip.

When a train or airplane makes a trip, its course is charted. You know exactly where it is to go. There is a careful plan followed for each trip.

Ten Trips is played according to a plan. There are rules to follow. It is unfair not to follow the rules of the game. This is the way each trip is mapped out for the ball or beanbag. Each team follows this plan for Ten Trips:

Number one throws to number three
Number three throws to number two
Number two throws to number one

Each time number one receives the ball or bag he calls, "One trip." The contest continues until one team has ten trips to its credit. You play this game well if you throw and catch well. Before you start the race of ten trips with a ball or beanbag, practice throwing and catching.

There are certain things you must keep in mind when you play Ten Trips. Players who have numbers one and two have only half the length of the playing space to throw. The players with number three must throw the entire distance. Also, you must know when you are thinking too much of the speed of the trip and not enough of the skill of the game.

Things to Remember

1. Your body is made of many kinds of material which must be supplied in the food you eat.
2. It is important that the food you eat performs all the functions to maintain the body in health.
3. The foods in the basic seven food groups provide the basic food elements.
4. There are many foods not included in the basic seven food groups that furnish chiefly energy. These foods may be eaten in addition to the basic seven foods, but should not take their place.
5. Some foods may have more of one element or another, but the elements are there mixed together.
6. There is no one food which contains all the elements in proper amounts to keep people alive.
7. It is necessary to eat many different foods to supply all the needs of the body.
8. The six basic elements in foods are proteins, carbohydrates, fats, minerals, vitamins, and water.
9. Water is vital to every living thing.
10. Minerals help to regulate body functions.
11. Vitamins help to regulate body functions.

Study Exercises and Questions

1. Name two or more leafy, green, and yellow vegetables.
2. Name two citrus fruits.
3. Name two vegetables you eat raw.
4. Name two dried fruits.
5. What are the cereal grains?
6. Name the six basic elements in all foods.
7. What food is the most excellent source of protein?
8. What foods contain starch?
9. What is the scientific name for sugars and starches?
10. What part of the animal do you eat when you eat lean meat?

Suggested Activities

1. Help your mother plan her grocery order which would include green and yellow vegetables.
2. Cut a potato in two. Note how it feels. The halves of the potato feel moist. Weigh the potato and record the weight. Then cut the potato up into thin slices. Let the slices stand for several hours. Then reweigh these slices. Does the potato weigh more or less the second time you weigh it? Why? Explain what these experiments prove.
3. Take a hammer and crush a peanut on white paper. Brush the pieces to one side and look at the spot on the white paper. What does the spot on the paper look like? What elements in the peanut made the spot?

4. Make a chart like the one shown here. (Do not write in your book.)

	Milk	Potato	Meat	Peanut
Protein				
Carbohydrates				
Starch				
Sugar				
Fat				
Minerals				
Vitamins				
Water				

Place a check mark, on the chart you draw, opposite each element you can plainly see in the foods tested.

Place an X mark opposite each element the food contains that you cannot see.

Place an O opposite each element not contained in thc food.

Explain what the chart tells about the four foods and about the elements in foods.

5. See whether you can make a chart of the basic food elements contained in any other foods.

Words to Master

tissue	sodium	homogenize
maintain	chlorine	mechanical
analysis	iron manganese	particles
scientific	magnesium	experiment

TRAVEL THE GOOD FOOD ROUTE TO HEALTH

CHAPTER IV

WHAT THE VARIOUS FOODS WILL DO FOR YOU

Foods as Body Builders

What Foods Supply. In Chapter One you learned the four reasons why you eat. These reasons are:

To build new tissue for body growth

To repair and replace worn-out parts of the body

To furnish heat and energy

To regulate the body functions and protect the body from disease

The various foods you eat will do these things for you. Foods will help your body build new cells, tissue, and bones. Foods will repair and replace worn-out cells and tissue. Foods will furnish heat and energy. And finally, foods will regulate your body processes. In this chapter you will learn about the first three things that foods do for you.

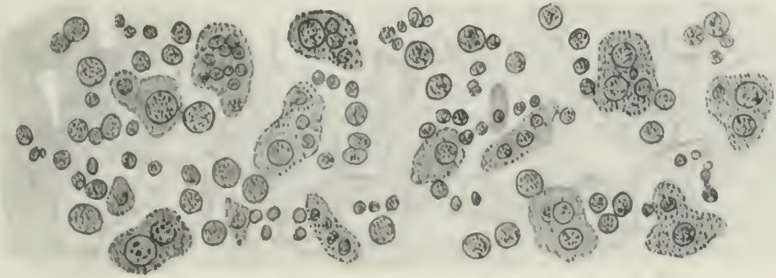
Cells and Tissues. All living things are composed of cells. Cells have the ability to divide and multiply. In dividing and multiplying, the cells form many groups. The groups of cells then form themselves into tissues. Several tissues then combine or join together to form muscles or organs.

The various organs make up the systems in your body. These systems perform certain special functions in the body. For example, the digestive system makes it possible for you to digest your food. The muscular system controls the movement of your body. There are other systems in your body. Each system performs a special function in the human being.

Thus it is that the human body is made up of systems. Systems are made up of organs. Organs are made up of tissues. The tissues are made up of cells. The human body comes from the simple cell.

How Your Body Grows. Your body is a structure built of bones and muscles, organs, and glands. The whole structure does not remain the same all the time.

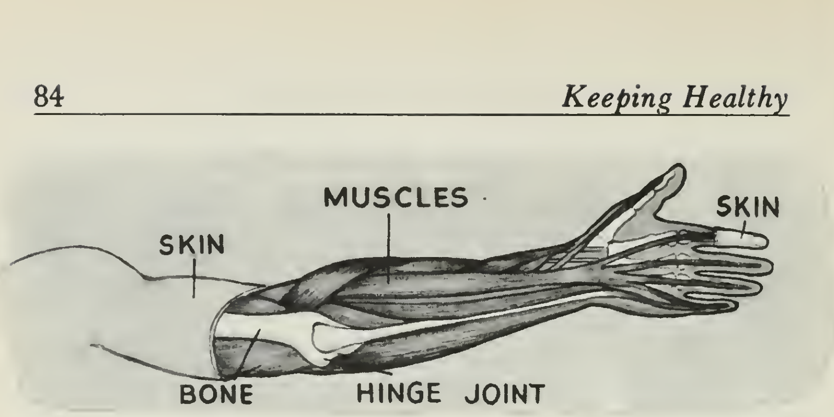
The bones, muscles, glands, and organs are made up of cells and tissue. The cells are the smallest living organisms. They cannot be seen without a microscope. The cell is the basis of all living animals and plants. As the cells grow they divide and create more cells. Tissue is a mass of cells and the substance



around them. Tissue grows as more and more cells are accumulated. Tissue in turn makes animal and plant bodies grow.

At two years of age a child may weigh twenty-six pounds, and be thirty-three inches tall. The same child at eleven years of age may weigh seventy pounds and be fifty-four inches tall. The difference of forty-four pounds and twenty-one inches represents a considerable growth in weight and height.

Certain parts of the body have grown and increased in size. What really has happened is that the body has become larger. During the years from two to eleven, the arms and legs have grown longer. The trunk of the body has become longer and larger. The head, hands, feet, and other parts of the body have also grown larger. As an example of growth, consider the arm.



The arm is made up of bones, muscles, and skin. The bones of the upper and lower arm are joined at the elbow in a hinge joint. The muscles surround the bones. The muscles and bones are covered by skin. When the arm grows bigger, the bones grow longer and stronger. The muscles get bigger around and become longer. The skin increases in size to cover the larger muscles and bones. This means that there is more material in the bones and muscles of an eleven-year-old than in a two-year-old child. The material which built the bones and muscles came from the food which was eaten by the child.

Refer to the picture on page 13 of this book. This picture shows a man building a wall and a girl eating. Perhaps the wall that the man is building is the wall of a house. One day the house will be completed.

The little girl in the picture is building a house too. She is building a body just as you are by eating certain kinds of food. One day her house and yours will be completed. But there is one very great difference between the house you build for yourself and the one the mason builds. The bricks which compose the mason's house will be the same bricks ten years from now that they are today. But the muscles, bones, and skin of your house will not be the same muscles, bones, and skin ten years from now that they are today. Neither are they the same today as they were ten years ago.

Growth of Hair. The growth of some of the parts of your body can be seen. A good example of this is the hair. The hair grows from the skin. That part of the hair in the inner layer of skin is called the root. The root cannot be seen. That part which you see above the surface of the skin is called the shaft. The ends or shafts of hair keep growing longer.

When their hair grows too long, boys and men usually have a haircut. After a haircut a person's hair looks neat and trim. The hair does not stay that way very long. In about two weeks the hair is longer again. A new length of hair has grown out

to replace that which was lost by cutting. So a person has to have it cut again. Hair is alive at its roots.

As the ends grow out and are cut off, the new portion pushes out from the roots. Therefore, the hair you have today is not the hair you had last year. It is new hair. It has been made from new materials.

Growth of Fingernails. Another good example of growth which can be seen is the growth of your fingernails. All of us know how fast fingernails grow. When fingernails get too long, you file or cut them off. Within a few weeks the fingernails grow longer and must be cut again. After this has been done enough times, a person is cutting quite a different nail from the one that was cut the first time. The nail grows from the little crescent at the base to the top where it is cut. It takes several months for a complete new nail to grow. This year's nails are, therefore, different from last year's.

The examples of growth about which you have just read are processes that can be seen with your eyes. But similar processes are taking place all over your body all the time.

Growth of Skin. The skin which covers your body is made up of two layers. These two layers are the surface skin or epidermis and the inner skin or dermis. The surface layer of skin is constantly being worn off. As the surface layer wears off the inner layer takes its place. This you do not feel or even very often see. The skin is constantly being changed a little at a time, even though you are not aware of it. The surface skin is being constantly renewed. It is being replaced by new materials from the inner skin.

It is perhaps harder to understand that the muscles and bones under the skin are going through changes of a similar nature, but they are. This happens today and every day.

How Parts of the Body Are Maintained. You have learned that parts of the body are continually growing. The substance of which bones and muscles are made becomes used up and more substance must be supplied.

The bones, muscles, and skin—things that give size, shape, and color to the body—remain the same in appearance. The material of which they are made is constantly changing. The changes are slow in the body but they take place just the same. Food, which you must have every day, builds your body and maintains its size, its shape, and its color.

Protein for Growth and Maintenance. The kind of food you must have every day to build and maintain your body is protein food. Protein is the food element which cells must have to grow. Protein is necessary for cell division and increase. Protein is contained in every living cell. All living tissues contain protein. Protein is necessary for the accumulation of cells into tissue. Protein is necessary for the forming of organs from tissue. Muscle tissue is made of protein. This is also true of gland tissue.

Protein in varying amounts is used by the body in making all kinds of tissue. Protein food is important for the purpose of building and maintaining the body structure. Life itself depends on protein.

Protein is needed by your body to provide for:
1. Building material—the source of new tissue growth
2. Repair and replacement—cells or tissues wear out and have to be replaced
3. Heat and energy—fuel—when the diet is lacking in carbohydrates and fats.

The fourth and fifth basic food groups contain foods that are excellent sources of protein. These are meat, milk, poultry, cheese, and eggs. Protein is contained in both animal and vegetable foods. All the basic seven food groups have foods that contain some protein. Therefore, one should eat a wide variety of foods from the seven food groups. These foods will supply the protein needs of the body. Foods that contain protein make body parts grow and also help to maintain them.

Calcium, Phosphorus, and Iron. The life of a cell depends upon food. One of those foods, you learned, is protein. Other food elements are necessary for cell growth. Unless the food contains minerals and vitamins, the cell will not grow.

All living cells depend on certain minerals—iron and phosphorus and calcium—for growth, life, and activity. However, all the minerals play an important part in the life and growth of the cells. The mineral elements are found in the muscles, bones, teeth, blood, and all other parts of the body. They enter into the structure of the body. They are highly important for the growth of the cells.

Foods as Sources of Heat and Energy

The Needs for Heat and Energy. The body requires a supply of energy to carry on life activities. It needs energy to do its work. The human body can be compared to an engine. The body needs fuel or energy to keep it going. There is an important difference between the two, however.

An engine needs fuel or energy to do some kind of job. The engine may be in an automobile. Automobile engines use gasoline for fuel. The gasoline supplies the energy to run the automobile. When the ignition key is shut off, the engine or motor stops

running. It is no longer working. The engine is completely at rest.

Such is not the case with the human body. The living body is never completely at rest. It must carry on life processes when you work, when you play, when you rest, and when you sleep.

The Use of Energy. The internal organs of the body are constantly performing internal work. The heart beats and uses energy. Your breathing apparatus, lungs and chest, move automatically and use energy. This is true of the liver, kidneys, stomach, intestines, muscles, and all the glands. Energy is necessary to keep up the vital processes.

When you walk, run, play, work, and move about, you need more energy. No matter what you do, it requires the use of energy. Every movement of the hands, arms, feet, and body requires the use of energy.

The boy who is riding a bicycle will use more energy than a boy walking.

The farmer will use more energy when working than will a man sitting at his desk writing. And so it goes; the more active you are, the more energy you use. The harder you work, the more energy you use. The harder you play, the more energy you use.

This means you must eat more food to supply the needed energy to perform more work. The harder you work, the greater is the amount of food needed. The harder you play, the greater is the amount of food needed.

The Use of Heat. Heat and work are very closely related. When you roller-skate for a while, you become warm. When you ride your bicycle for a while, you may feel warm. The same is true when you work for a while. When you mow the grass, for example, you get warm, then hot, and perhaps perspire. This is because your muscles are working. No work can be done without producing heat. No exercise can be performed without producing heat. Whenever you exercise, extra heat is produced by the body. This extra heat is carried by the blood vessels to the skin surface where it passes off the body through evaporation of perspiration and is lost.

Carbohydrates and Fats—Energy Foods. Energy is furnished by the food you eat. The food supplies heat to the body. The heat is transformed into energy. Energy is the power to do work. Foods that produce heat and energy are carbohydrates and fats and oils. They are found scattered throughout the basic seven food groups. But the foods listed below give chiefly energy.

Bacon
Drippings
Lard, and other
  shortenings
Mutton fat
Poultry fat
Salad dressings
Salad oils
Salt pork, fat
  back
Suet

Honey
Jams
Jellies
Molasses
Preserves
Sirup
Sorghum

Corn meal,
  degerminated

Cornstarch

Hominy grits
Macaroni
Noodles
Rice, white
Spaghetti

Unenriched:
  Crackers
  White bread,
    rolls
White flour

Cakes
Candy
Chocolate
Cocoa
Cookies
Pastries
Sugar
Other sweets

These foods include those listed in groups six and seven. The foods in basic group six also contribute much carbohydrates. The fruits supply mainly sugar. Some of the vegetables also supply starch. The body uses carbohydrates, fats, and proteins for fuel.

The engine in an automobile uses gasoline for fuel. But again there is an important difference between the human body and the engine. When the gasoline in the engine is burned up, it stops running. It stops because the gasoline, which furnishes the heat and energy to make it run, is used up.

The human body keeps on running. It keeps on using energy to maintain life processes. The body has the ability to store surplus energy. This surplus energy is drawn upon when needed. Protein also supplies some energy when carbohydrates and fats are lacking in the diet.

Measuring the Energy Value of Foods. You know that gasoline is used to make the automobile engine run. You know that one gallon of gasoline will run an automobile between fifteen and twenty miles. That means one gallon of gasoline furnishes enough energy to make the automobile travel between fifteen and twenty miles. In like manner you can determine the energy value in the foods you eat. It is possible to measure the amount of work that a person can do on a certain amount of food.

The amount of work that can be done on a certain amount of food eaten is measured by a calorie.

The word calorie is used to express the fuel or energy value of food. Calorie is a heat unit that is used to measure the amount of energy in foods. It is defined as the amount of heat necessary to raise 1 kilogram (2.2 pounds) of water 1° on a centigrade thermometer, or 4 pounds of water 1° Fahrenheit.

The calorie measures the heat given off by the body. The heat comes from the food we eat. The heat value of food can be measured by burning the food in a special type of apparatus. A weighed amount of food is burned under a weighed amount

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Measuring the heat contents of a piece of coal.

of water, and the rise in temperature is noted. In this way it was discovered that:

1 gram of pure fat yields 9.3 calories
1 gram of pure carbohydrates yields 4.1 calories
1 gram of pure protein yields 4.1 calories

Heat Values of Certain Foods. In Chapter Three you learned what basic elements were contained in foods. Now you have learned how the amount of energy in foods is measured. The amount of energy in foods is known as the heat value or fuel value. This is usually expressed in calories. When you know the basic elements of a food with these fuel values, it is possible to measure the energy value of the food. For example, two slices of bread (white or whole wheat) one half inch thick when burned would raise the temperature of the measured amount of water 100° F. Therefore, you say two slices of bread contain 100 calories or heat units. Every food that you eat can be so measured.

Scientists have been able to calculate 100 calorie portions of food. They discovered the exact amount of each type of food which will yield 100 calories of body fuel. The following table gives a list of foods with amounts that yield 100 calorie portions:

Food	Calories
Milk—whole—5/8 cups (5 oz.)	100
skimmed—1 1/8 cups (10 oz.)	100
Bread—white, whole wheat—2 slices, 1/2 inch thick	100
Butter—1 tablespoon	100
Apple—1 large, 3 1/4 in. diameter	100
Cereal—cooked oatmeal 3/4 cups	100
cornflakes 3/4 cups	100
Eggs—whole—1/3	100

When you eat any one of the foods in the amounts listed in the table, it will give to your body 100 calories or heat units or energy units. Scientists have discovered how much energy or work the human body can get from each article of food it uses.

Energy Requirements of the Body. Scientists have also discovered how much energy the body requires every day. This amount will vary in individuals. The amount required depends on how active a person is. It has already been stated that the harder you work, the more energy the body needs. The age of a person also determines how much energy is needed. A younger person requires less energy than an older person does. The following table gives the average energy requirements for twenty-four hours.

Boys—10-11-12 yrs.—need about 2400 to 2500 calories per day
Girls—10-11-12 yrs.—need about 2400 to 2500 calories per day
Boys—13-14 yrs.—need about 2800 calories per day
Girls—13-14 yrs.—need about 2600 calories per day
Men—average with moderate activity—3000 calories per day
Women—average with moderate activity—2500 calories per day

The Reserve Supply of Energy. When the auto engine runs out of fuel, it stops. The human body does not. It keeps on running; the life processes keep on going all the years of your life. In the table above, it was indicated that a boy or girl eleven years of age needs an average of 2400 to 2500 calories per day. This amount will be increased if the boy or girl becomes very active. The amount of activity may increase the calorie needs for the day. The extra calories come from a reserve supply which is stored in the body. When you run out of energy which you get from the food you eat every day, you draw from a reserve fuel supply.

When you fail to take in enough energy food at all three meals, then more and more has to be drawn from the reserve supply. Should this happen often, the reserve supply may be used up. When this happens, the person begins to lose weight and becomes thin. The human body takes in food and uses it for heat, energy, and growth. When too little food is taken in, the energy demands of human activity are met by withdrawing stored fat from the body. When there is no stored fat, then the body becomes thin, supplying the energy by burning the stores in muscle tissue, liver, and other glands. Before all the stored fat is used, the body begins to draw upon the stores in muscle and other tissue.

When the food intake (protein, fat, carbohydrates) balances the energy outgo (heat, work, play, activity), the body does not lose or gain weight. If, however, the food intake does not balance the energy outgo, a person may lose or gain weight. Steady gain in weight is the result of increased intake with no increase in outgo. This results in added fat on the body. A certain amount of fat is necessary for the protection of internal organs. Fat is also necessary for an emergency source of fuel. Steady loss of weight is the result of an outgo of energy greater than the intake of food. Then the body draws upon the reserve stores, as you have read.

Activity for Health

Softball. When you play softball, you have many things to remember if you are to play the game well.

Thinking about these things and discussing them will help you learn to play this popular American game.

The court or the playing area is a diamond shape. There are three bases and a home plate which is also called a base. A pitcher's box is placed about thirty-five feet from the home plate.

There are two teams. Ten players make up each team. Each player on the team has a special position. He takes this position when his team is out in the field. Players bat in regular order. When the team is batting, each one has a turn to bat. A soft ball which looks like a baseball is used. It is larger than a baseball, but not as hard. It is safer to play with because it is not as hard. A bat is used to hit the ball.

Each player on a softball team has his own job in the game. It is an important job. If a player is a good team member, he knows what he has to do and does it to the best of his ability. It is possible for a team player to score one point for his team if he hits the ball fairly, if he runs the bases, first, second, and third, in regular order, and reaches the home plate before he is put out.

There are many rules to remember and to observe.

Players must bat the ball within the play area.

Players must run on the outside of the bases when they run from one base to another in regular order and if stops are not made at each base.

One point is scored if a player reaches home plate safely.

Things to Remember

1. All living things are composed of cells.
2. The human body is made up of systems, each one of which performs a special function.
3. Your body is a structure built of bones, muscles, and organs.
4. Parts of the body are continually growing and being renewed.
5. Protein is the food element that makes cells, tissues, and organs grow and also maintains them.
6. Protein is contained in both animal and plant foods.
7. Meat, milk, poultry, cheeses, and eggs are excellent sources of protein.
8. All living cells depend on certain minerals—calcium, phosphorus, and iron—for growth, activity, and life.
9. The body requires heat and energy to carry on life activities.

10. Carbohydrates, fats, and oils are the foods that produce heat and energy.

11. The amount of work that can be done on a certain amount of food eaten is measured by calories.

12. A boy or girl ten, eleven, or twelve years old needs an average of 2400 to 2500 calories of energy food per day.

13. When too little food is eaten, energy demands of the body are met by withdrawing stored fat. When there is no stored fat, the body becomes thin supplying the energy demands from stores in muscle tissue, liver, and other glands.

14. If a person steadily gains weight, the amount of energy foods eaten exceeds the amount of energy food used and too much fat is stored in the body.

Study Exercises and Questions

1. What does protein food do for your body? Carbohydrates food? Fat food?
2. Why is it important to eat a good breakfast?
3. What causes some people to become thin?
4. What causes some people to become fat?
5. Why should a person keep some reserve of fuel or energy for emergencies?
6. How can a person build up a reserve of fuel or energy?
7. Why is milk an important food?
8. Which food elements are necessary for growth and repair of the body parts?
9. Which foods supply heat and energy?

Suggested Activities

1. Make a list of foods included in your diet for one average day. Check the list to see how many of the basic seven food groups are represented.

2. Make a list of the systems in the body and see whether you can tell what each one does for you.

3. If a microscope is available, perhaps your teacher will permit you to look through it at a piece of raw, lean meat and a piece of fat meat. Make a drawing of one of them as seen through the lens. Write an explanation of what you see.

Words to Master

calorie	structure	digestive
gram	reserve	muscular
moderate	processes	organisms


TRAIN
DISPATCHER
ALL THINGS THAT RUN
MUST BE REGULATED

CHAPTER V

ADDITIONAL FUNCTIONS OF VARIOUS FOODS

Foods for the Regulation of Body Functions

The Importance of Minerals. You have learned that foods contain proteins, carbohydrates, and fats. You have also learned that these elements are essential for building new material, for repair and replacement of cells or tissues, and for supplying heat and energy. There are other elements that are important to the body. Some of these elements are minerals. Minerals occur in foods in relatively small amounts in contrast to proteins, carbohydrates, and fats. The minerals as well as proteins are sources of building material. They are used for building new parts and replacing worn parts. Minerals do not produce heat and energy. They are necessary for regulating body processes.

You are now going to learn how necessary these minerals are for regulating body processes. You know that the human body is made up of cells, tissues, organs, and systems. These parts in turn are

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Student nurses studying a model of the organs of the human body.

all composed of different chemical elements. It is interesting to note the chemical composition of the body in terms of elements. The following table gives the names of the chemical elements and the per cent of the human body that is made up of each.

Element	*Per Cent*
Oxygen	65
Carbon	18
Hydrogen	10
Nitrogen	3.0
Calcium	1.5
Phosphorus	1.0
Potassium	0.35
Sulphur	0.25

Sodium	0.15
Chlorine	0.15
Magnesium	0.05
Iron	0.004
Iodine	0.00004

There are traces in the body of other minerals such as fluorine, silicon, copper, zinc, aluminum, manganese, and others.

General Sources of Minerals. Most of these minerals are supplied adequately in the average diet. Only a few need special consideration in food selection. Minerals are found in both animal and plant food. Plants obtain minerals from the soil and water. Animals eat the plants and thus absorb the minerals in the muscle tissue or meat.

Oxygen, carbon, hydrogen, nitrogen, and sulphur are found in proteins, fats, and carbohydrates. The proteins are the only foodstuffs which can supply nitrogen. Nitrogen is found in every living cell in the body. It is essential for life.

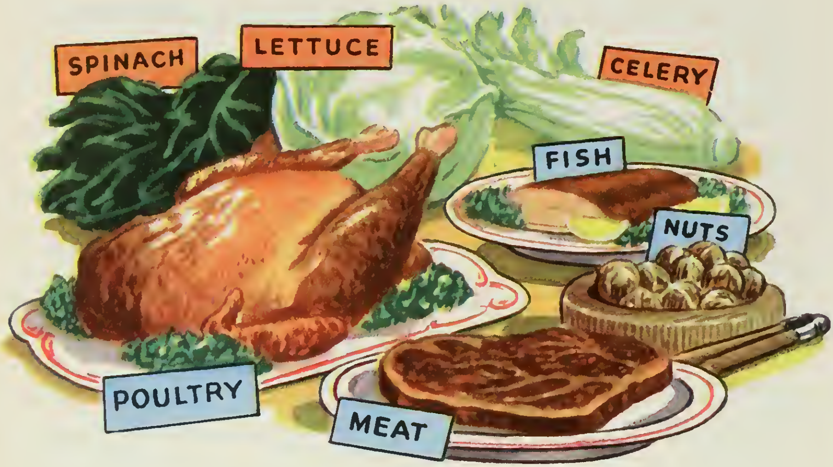
Calcium and Phosphorus. Calcium and phosphorus are found in the bones and teeth. Nearly all, about 90 per cent, of the calcium is found in the bones. Calcium and phosphorus are necessary for proper growth of good strong bones. Calcium and phosphorus are also necessary for good teeth. Without calcium we would not walk or move about. Calcium also helps in the clotting of blood when you scratch or cut yourself. It also helps in the contraction of muscles and in controlling nerves. Phosphorus is found in every living cell.

Milk is the richest source of calcium. Milk is also a good source of phosphorus. That is why it is important to drink at least one quart of milk a day. The following tables give lists of foods rich in calcium and phosphorus.

Foods rich in calcium	*Foods rich in phosphorus*	
Milk	Liver	Oatmeal
Cheese	Meat, lean	Vegetables, fresh
Cauliflower	Veal	Nuts
Vegetables, fresh, leafy	Poultry	
Oysters	Fish	
Beans, navy and lima	Lamb	
Fruit, fresh	Pork	
Nuts	Beef	
Eggs	Milk	
Fish	Oysters	
Meat	Cheese	
Oatmeal	Eggs	

Iron and the Blood. You learned about parts of the body that are the same in size, shape, and color all the time, but are being renewed all the time. So it is with the blood. You have about the same amount of blood in the body all the time. The iron which gives blood its color is changing. The iron in the blood is being used up all the time. Every day you have to eat food which contains enough iron to replace that which is used.

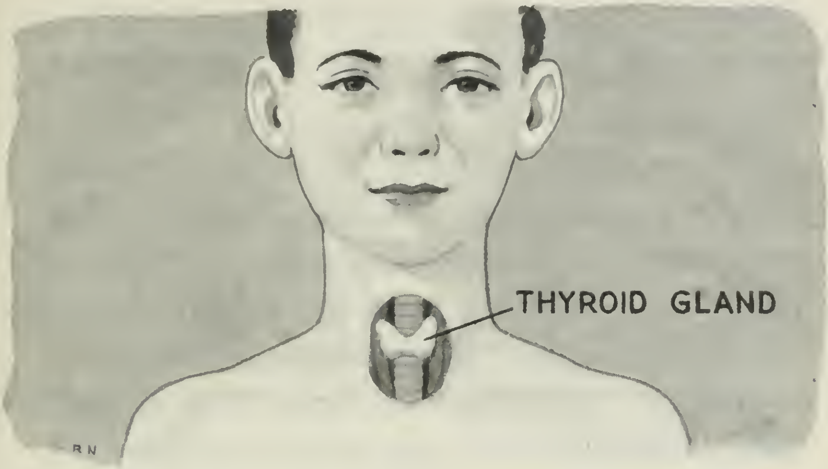
Iron is found in the red blood cells of the body. It is combined with a certain chemical substance in the body and carries oxygen to the tissues. Oxygen is necessary for life and every cell in the body



requires oxygen. Without iron you could not use oxygen. When the iron content in the red blood cells is low, the person is weak and tires easily.

Iron also comes from your food. All food does not supply iron to the body. Some foods are good sources of iron. These foods are liver, meat, fish, poultry, dried legumes and nuts, and leafy green vegetables. It is important to know what foods have iron in them. You are making blood every day.

Iodine and the Thyroid Gland. Iodine is another mineral which is necessary for our health and life. The thyroid gland located in the neck contains about one tenth of a drop of iodine.



Iodine is needed to regulate your energy level. Lack of iodine in the diet causes the thyroid gland to become enlarged. This condition is called goiter. When the thyroid gland is not properly fed with iodine, the growth and activity of the body is not regulated correctly. Body functions are thrown out of balance.

Iodine is a mineral found in the ground. Fruits and vegetables growing in the ground can pick it up. They put it in their roots, stems, leaves, fruits, flowers, or seeds.

Since that is true, it would seem that everybody should get enough iodine. But the curious thing is that iodine is not found in the soil of some parts of this country. Some parts of other countries do not have iodine in the soil.

The soil within 100 miles of any of the Great Lakes is entirely lacking in iodine. This means that carrots and peas raised in Cleveland or Buffalo or Chicago will not have any iodine in them. People who live in cities bordering on the Great Lakes cannot depend upon the home grown fruit and vegetables to furnish iodine to the body. This being the case, they must get their iodine from other sources.

Sources of Iodine. People who live in the Great Lakes area might get fruits and vegetables which come from other parts of the country. They might obtain oranges from California or Florida. They might get potatoes from Maine or Idaho. They might get lettuce, carrots, celery from Texas and New Jersey, and they might buy many more foods from various parts of the country. However, fruits and vegetables grown in any part of the country are only fair sources of iodine.

The best sources of iodine are salt-water fish, oysters, clams, and other sea food. The reason for this is that sea water contains much iodine. Iodine is also contained in the soil near the sea. Therefore, vegetables grown in this soil contain iodine.

By using iodized table salt, a person can get a certain amount of iodine in the diet. Iodized table salt is salt which contains a small amount of sodium iodide. This element is added to salt when it is manufactured. Not all the salt sold on the market is iodized salt. Salt that is iodized has that fact printed on the label.

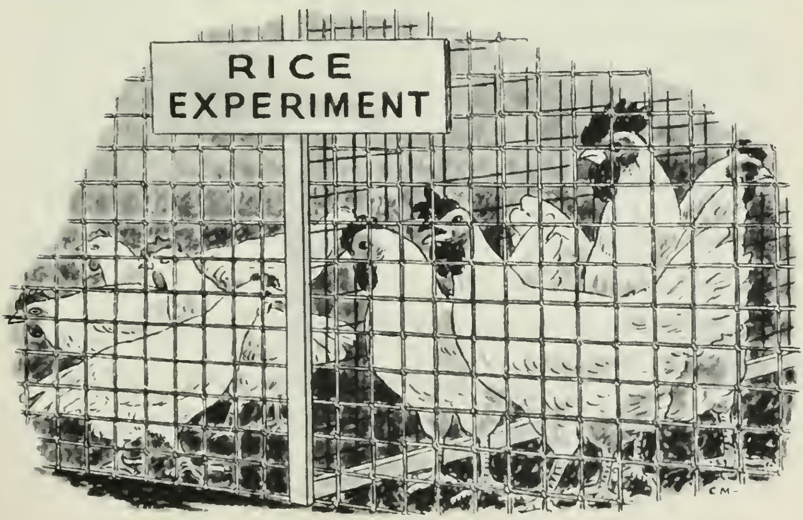
Minerals and Your Diet. You have read about the most important minerals which help regulate the body functions and promote growth. Special efforts must be made to include foods in your diet which contain calcium, phosphorus, iron, and iodine. The other minerals included in the list are also important to make your body parts grow and to maintain them. However, potassium, sulphur, sodium, chlorine, magnesium, and traces of other minerals are seldom lacking in the food you eat.

The Health Protecting Foods and Body Regulators

Vitamins. Thus far you have been studying about the important food elements which you eat every day. For a long time the four elements, proteins, carbohydrates, fats, and minerals, were thought to be the only ones present in all foods. Then scientists discovered that foods contained a fifth element. This fifth element plays an important role in maintenance of health, growth, and protection from certain diseases. This fifth element, like the minerals, is also important for the regulation of body functions.

In planning meals or a diet, you make up several teams of food products. One of the vitamin families has a team. They work together in your body to make you feel fit. They help you to overcome fatigue. They give you an appetite for wholesome food three times a day, seven days a week. They help to regulate the functions of your body. Sometimes boys and girls cannot play as well as they should in their games. Perhaps something from the vitamin family or team has been omitted from the foods they eat every day. You should eat regularly and plan to include members of the vitamin team in your daily meals. Now you will learn other interesting facts about vitamins.

A Cure for Beriberi. In 1897, Dr. Christian Eijkman in Java, of the Dutch East Indies, gave us our first clue about the missing fifth food element. In those days in Java, in fact all over the East—China, Japan, and the Philippines—the natives suffered from a disease known as beriberi. People who had the disease became very thin and lost their strength. It hurt them to stand or even sit down. They could do no work. But there, as anywhere, when disease strikes, were men trying to conquer it. In this case it was Dr. Christian Eijkman and his friend, Dr. Grijna. Experiments were performed on chickens by feeding them polished rice. This produced a nervous disorder in chickens



similar to beriberi in humans. Efforts were then directed toward finding a cure for the disease. The discovery was made by accident.

One of Dr. Eijkman's assistants threw some whole rice into one of the chicken pens for a few days. Whole rice is the kind that still has the silvery outside coverings on it. The chickens in this pen were cured of their disease. The chickens which continued to be fed on polished rice showed no improvement.

The Beginning of Research on Vitamins. Little did these men suspect in 1897 that there is a fifth element, an element necessary for the life and well-being of all people. Their concern was with curing a disease which had defied all cure up to that time. But the idea they had about the mysterious something in the rice polishings was the clue. It was a clue which started other scientists off in their search for the things which make children grow and protect them from disease.

In 1906 a famous English food scientist, Sir Frederick Hopkins, proved that whole milk contained some unknown substance necessary to the life and growth of rats. This unknown substance was not present in the purified proteins, carbohydrates, fats, and minerals contained in milk.

How Vitamins Got Their Name. Then in 1912 Casimir Funk, a Polish scientist, gave a name to these mysterious substances in milk and other foods. He called them vitamins, meaning "life-givers." Dr. Funk thought that the new elements belonged to a family of chemical substances known as amines. Therefore, he made up the word vitamines. Today, you know that the early work of Dr. Funk is not correct, but the name he made has been kept with the final "e" left off. The word is spelled v-i-t-a-m-i-n.

Importance of Vitamins. By conducting animal feeding experiments, scientists discovered that vitamins were necessary for life and that the lack of vitamins caused many kinds of diseases. There are many members in the family of vitamins. When these members were first discovered, people did not know much about how they were made, so they were simply described by letter, A, B, C, and D. Today, scientists, however, do know about many more vitamins. Although each one is now given a specific chemical name, they are frequently referred to by letters of the alphabet. The vitamins, the fifth element, are called health protecting foods.

Vitamin A. This vitamin is necessary for growth. It helps to protect against infections and colds, keeps the skin healthy, and strengthens the eyes. Vitamin A is found in butter, cream, milk, eggs, highly colored fruits, yellow root vegetables, and fish liver oils.

Vitamin B. It has been discovered that there is a group of vitamins B—ten in number. None of them occurs singly in foods. They are always found in combination with one or more others of the ten. It is known that when vitamin B is missing from their diet, children suffer from loss of weight, loss of appetite, listlessness, nervous indigestion, and fatigue. To supply vitamin B, your diet should contain whole grain cereals, fruit, cabbage, lettuce, spinach, milk, yeast, and nuts.

Vitamin C. Lack of vitamin C causes a disease known as scurvy. This disease was common among sailors on ships in early days. It took a sailing vessel from six to fourteen weeks to get from America to Europe. The food they carried consisted chiefly of dried and salted beef, hardtack, and water. Modern means of refrigeration and cold storage did not exist. It was, therefore, impossible to carry fine fresh fruits, meats, and vegetables. It often happened that some of the men fell ill before the journey was over. At first they became very tired. No matter how much they ate or slept, they did not seem to have any strength. Then by and by their legs and arms began to ache and their joints to swell. Also, their gums would bleed and their teeth became loosened.

It has been discovered that citrus fruits, lemons, limes, oranges, and grapefruit, contain the food element, vitamin C, which prevents scurvy. Other good sources of vitamin C are raw or cooked tomatoes, raw fruits, vegetables, and milk.

Vitamin D. Vitamin D, as well as calcium and phosphorus, is needed to build strong bones and teeth. Lack of this vitamin in the diet causes rickets, a disease of the bones. When a child has rickets, the bones of the legs and thighs are too weak to support the weight of his body. As a result, the child may become bow-legged. Other signs of the disease in growing children may be a hollow chest, round shoulders, and poor posture.

Vitamin D does not occur abundantly in foods as do the other vitamins. The richest source is found in fish-liver oils, such as cod-liver oil and halliver oil.

Sunlight, a Source of Vitamin D. Sunlight plays a very important role in the prevention of rickets, especially in the summertime. Your skin contains a chemical substance which is changed to vitamin D when direct sunlight reaches the body. It is the action of ultraviolet rays on the skin which makes this possible. Summer is the time when the ultraviolet rays of the sun are strongest. In fall, winter,

or spring, you probably do not receive many benefits because the rays are weakest during these seasons of the year. There are factors, however, which destroy or reduce sunlight's vitamin D benefits. Some of these are clouds, dust, smoke, rain, fog, shade, darkened streets, and dark clothing. Plenty of outdoor activity in the summertime will help prevent rickets. In the wintertime efforts should be made to include fish-liver oils in the diet. One should also drink irradiated milk. This is milk that has passed under ultraviolet light. In so doing, milk absorbs the vitamin D.

Big dairies use a carbon arc to irradiate milk. The carbon arc is lowered into the tank of milk. Milk flows over the surface of the walls of the tank and the vitamin D in the rays of the arc light enters the milk flowing past. You buy this milk and get vitamin D in it.

Exposing the body for brief periods of time under sun lamps that produce ultraviolet rays is also helpful. Care should be taken not to overexpose the body under a lamp or sunlight and care should be taken to guard against sunburn which may be harmful.

Vitamin D is supplied naturally to the body by sunlight. In the absence of sunlight we must get vitamin D from these sources.

Cod-liver oil and fish-liver oil concentrates

Fish-liver and eggs—food sources

Irradiated or vitamin D milk

Artificial sunlight—sun or ultraviolet lamp

Scientific Discoveries about Vitamins. Scientists are continually discovering new things about vitamins. There are other vitamins which will not be discussed at this time. You have learned about the

more common ones, A, B, C, and D. When a person's diet contains foods from the seven basic food groups, all the essential vitamins will be supplied except D. You were told how to obtain vitamin D in the preceding paragraphs. Vitamins will be secured in a well-balanced daily diet containing the basic foods. Vitamins from natural sources are preferred to prepared vitamin pills or capsules. Synthetic vitamins should not be taken by a person unless they have been prescribed by a physician.

Daily Food Planning

A Well-balanced Diet. It is important for every individual to have a well-balanced diet. A well-balanced diet is based upon a wide variety of foods. All kinds of food are good, but for health you need variety. As you have read, your bodies are made of many elements which must be supplied in the food you eat. You must have foods that contain proteins, carbohydrates, fats, minerals, and vitamins. You must have foods that supply materials for growth and upkeep — foods that keep your bodies in good running order.

The Seven Basic Food Groups as a Guide. As you have learned, you can get all the right kinds of food needed for health by using the basic seven food groups as a guide. The basic seven food groups provide a simple guide for the proper selection of food each day. Remember, most foods have food value, but wise combinations of these foods are essential to good nutrition. It is important for you to include some food from each of the basic seven food groups in the day's diet. Foods within each group are much alike in food value, so one food can replace another and give many choices in each group. A few foods are found in more than one group. Though all of the food groups could, and often do, appear in one meal, this is not necessary. It's the total for the day that counts.

Follow these simple rules in your daily food planning to build strong, healthy bodies.

Group	*Foods*	*Rule*
I.	Leafy, green, and yellow vegetables	One or more servings daily
II.	Citrus fruits, tomatoes, raw cabbage	One or more servings daily
III.	Potatoes and other vegetables and fruits	Two or more servings daily

Group	*Foods*	*Rule*
IV.	Milk, cheese, ice cream	Children, 3 to 4 cups milk Adults, 2 or more cups
V.	Meat, poultry, fish, eggs, dried peas, beans	1 to 2 servings daily
VI.	Bread,flour, cereals, whole-grained or enriched	Some every day
VII.	Butter and fortified margarine	Some daily
	Energy foods	In addition to basic seven foods but not in place of them

Water, the Sixth Element. You learned in Chapter III that water forms a large part of your body. You also learned that water is vital to all life. Neither animals nor plants can live long without water. Water helps to regulate the various body processes. It is especially important in the processes of eliminating waste matters from the body.

Activity for Health

Red and Blue. This game may be played indoors or outdoors. It is a running game. The players are exactly divided into two teams. One team is called

Red. The other team is called *Blue*. Teams face each other. They meet in the center of a space large enough to permit safe running. The space between the two lines should be about the length of an outstretched arm. If played outdoors, a wall or fence at either end of the running space may be the goal.

The leader is chosen to start the game. A score keeper helps the leader. They must be alert. The leader calls "Blues." Everyone must hear the call. The "Blues" run to their goal chased by the "Reds." All who are caught belong to the "Red" team and must help catch other "Blues." Both teams meet again in the center. The leader calls either one team or the other. This continues for a time limit. The time limit must have been agreed upon by both teams. Both teams must be called upon the same number of times. The team having the most players at the end of the game wins.

You decide whether you have been tagged. You must be fair and honest and join the other team players if you are tagged. You must be careful when you are playing this game not to run into other players. You learn to dodge and to run without hurting anyone. You need to watch carefully and to play safely. Many players can play this game at one time. Everyone has a turn to run. Good judgment and quick thinking are required of each player to run in the right direction. Safe playing requires each player to avoid running into others.

Things to Remember

1. Cells, tissues, organs, and systems are composed of different chemical elements.

2. Calcium and phosphorus are necessary for the growth of strong bones and good teeth, and calcium helps in the clotting of blood.

3. Minerals are necessary for regulating body processes.

4. Iron helps to make red blood cells and makes it possible for the body to use oxygen.

5. Iodine helps to regulate your energy level.

6. Minerals are found in both animal and plant foods.

7. Proteins are the only foodstuffs which can supply nitrogen.

8. Milk is the richest source of calcium.

9. Vitamins are essential to the protection of health and the prevention of disease.

10. It is important for every individual to have a well-balanced diet.

Study Exercises and Questions

1. What part do the minerals play in your body?

2. What part do vitamins play in your body?

3. At what time of the year do you get the most sunshine?

4. Why is there so much more sunshine on mountain tops than there is in the cities?

5. Why don't the sailors today have scurvy?

6. How was the first discovery made in connection with vitamins?

7. Make a list of the most essential minerals and tell what each does for you.

8. Make a list of the vitamins and tell what each does for your body.

Suggested Activities

1. Make a chart of the foods and the amounts, as accurately as you can estimate, that your three meals included yesterday. Then check the total amount for the day for the amounts of protein, carbohydrates, fats, calcium, phosphorus, iron, iodine, and vitamins included. According to the standards discussed in the text of this chapter, was your yesterday's diet good, fair, or poor? Outline a new diet indicating changes that would make your diet better.

2. Read the story *Heidi*. Be ready to tell how the sunshine and fresh air made the sick girl well.

Words to Master

chemical	thyroid gland	ultraviolet
irradiate	iodized	synthetic
concentrates	infections	indigestion


YOUR VISIBLE WORLD

CHAPTER VI

BACTERIA

What Bacteria Are

The World Around You. The world in which you live, the world you know about and can see all around you, is your visible world. In the visible world are houses, streets, automobiles, possibly some flowers, plants, and animals. But there is an invisible world which surrounds you also. It, too, is filled with things.

Invisible Plants. There are living plants too tiny for you to see or feel in this invisible world. Some of these invisible plants are helpful and useful to you. Some of them are harmful to you. For years you and your parents have been using the helpful ones. During these same years you have been fighting the harmful ones, sometimes successfully, and sometimes not.

These invisible living plants are called bacteria. They are the smallest living things. They cannot be seen with the naked eye.

Bacteria That Are Helpful

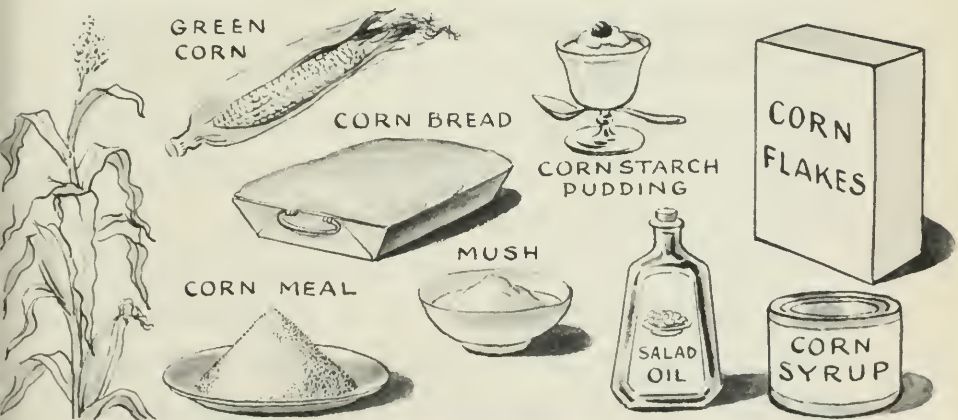
Disposal of Dead Matter. Bacteria may affect your life in a very helpful manner. In the presence of air or oxygen, bacteria will decay dead plants and animals. Dead plants that lie on the ground decay and gradually disappear into the ground.

Fertilizing the Soil. It is a good thing that dead plants decay and change into soil. In that way soil is made more fertile for new plants to grow. Leaves that fall to the ground in autumn also decay. In like manner, bodies of animals decay. Here again it is bacteria which cause the decay of the dead material. The fertility of soil depends upon this action of bacteria. The bacteria return the products of plant and animal decay to the soil. These products are simple elements which can be used again by new plants. You learned about these elements in your previous study of foods. Later on you will learn other ways in which bacteria are helpful to you. Now you will learn how plants use the soil fertilized by bacteria. Such plants are builders.

The Growth of Plant Builders. In Chapter Two, you learned that growing plants spend their lives making complex things out of simple ones. The leaves, stalk, and fruit of the plant are all made, little by little, day by day, out of material that the plant gets from the soil, water, air, and sunlight.

For example, the corn plant grows important food. You eat corn right from the ear. Many foods are made from corn. Some of these are breakfast cereal, corn meal, corn bread, corn mush, and cornstarch pudding. Others are salad oil, mazola, and corn syrup. The corn plant gets the material to make starch, sugar, oil, and even some protein from the soil.

Plants are called builders because they take simple minerals and water from the soil and carbon



dioxide and sunlight from the air. Then they make complex things such as starch, sugar, fat, and protein from them.

The Work of Bacteria in Nature. When a house is torn down, the wrecker or destroyer is able to recover from the complex house the simple substances of which it was built. These simple substances are nails, lumber, pipes, and other materials. In just such a fashion, bacteria are attacking dead cornstalks or other plant or animal substances. The bacteria plants of the invisible world are called wreckers. They break down the dead plant and animal substances into the simple food elements of which these substances were originally composed.

When you build something complex, you have to have supplies of simple things. So the green plant finds its supply of simple material in the soil. Every plant, as it grows, takes those simple minerals out of the soil and puts them into the complex substance of its body and its fruit.

Therefore, if a farmer raises corn one year, not much mineral matter is left in the soil for the next year's corn crop. These minerals must be replaced or there will not be enough food left for the plants.

The farmer may buy mineral fertilizer at the store to put back into the soil the simple minerals the plants have taken out. But the use of the farm waste material is a better and cheaper method.

Bacteria and Fertilizer. The farmer may save all the wastes from his cows, horses, pigs, chickens, and the straw used for bedding his animals. This makes an excellent fertilizer. It is spread over his fields in the spring. Then the waste material is changed back into simple plant food.

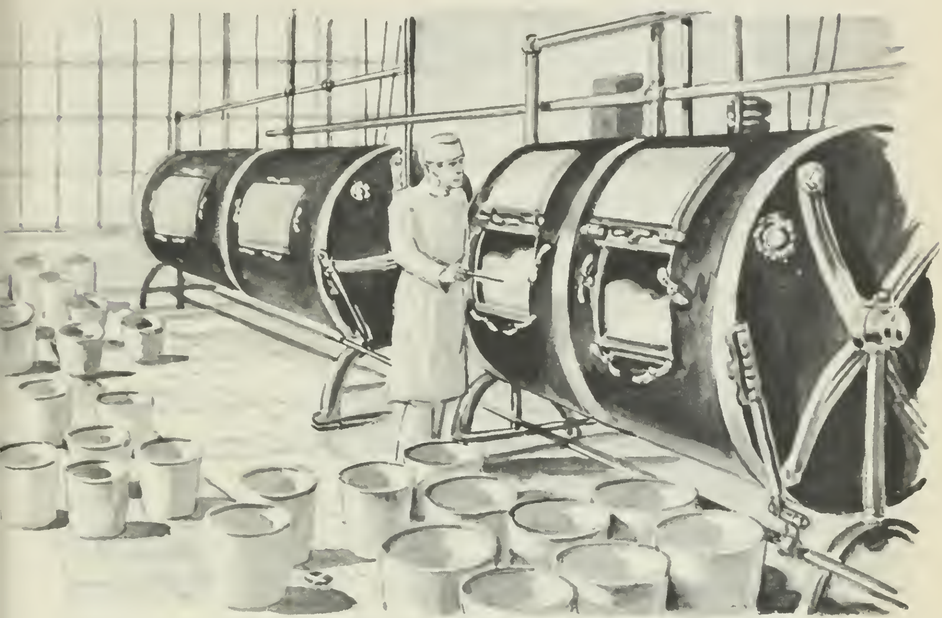
That is the work of the bacteria. They replace in the soil the minerals that are taken out by the plants. They do this by decaying the dead plants that have produced their fruits. They do this by decaying animals and animal wastes. All these things, dead plants and dead animals, the bacteria change from their complex state into the simple minerals. These simple minerals are nitrates, calcium, phosphates, and carbonates. This is the other half of the picture of building up and breaking down, which goes on in the soil day after day.

Bacteria must destroy just as green plants must build. That is their purpose. Now it is true that without green plants, we should all die. It is also true, that without bacteria we should all die. Without bacteria breaking down all waste material in the soil into simple minerals that plants can use, there would not be a continuous supply of plant and animal food for man to eat.

Using Bacteria in the Home. Bacteria are also important to the housewife. Bacteria cause sweet milk to sour. Many times this is a useful and helpful change. Sour milk has several important uses. Among certain races of people, sour milk is a favorite dish. Sour milk is sometimes recommended by physicians.

Some bacteria serve a very useful purpose in the preparation of certain foods. These are the bacteria which grow and multiply in or upon special food material. The changes they make in that material improve its taste and flavor. Men make a business of capturing and using these bacteria in the preparation of certain foods.

Bacteria and Making Butter. The dairyman makes use of bacteria in the manufacture of most of the butter that we eat. The flavor of this butter depends upon growing the right kind of bacteria to sour the cream from which the butter is made.



There is a certain kind of bacteria usually found in milk which makes the cream sour. The sour cream must be churned as part of the process of making butter. As the cream is churned, the particles of fat in the cream stick together in chunks. In this way they become separated from any milk that may have been in the cream. When the butter is churned sufficiently, it is removed from the churn. The butter is then washed, salted, and put into packages for sale.

In a butter-making factory several more processes are carried out, but the most important is preparing the cream. Cream brought in from many farms may have many kinds of bacteria in it. For that reason all the cream is pasteurized at the factory. This process destroys any harmful bacteria that might be in the cream. Then to this pasteurized cream is added a gallon or two of cream in which the factory has planted and grown a special kind of bacteria. This special kind of bacteria will sour the cream and give it a good flavor.

When butter is removed from a churn, there is a thin, watery liquid left in the churn. This liquid is called buttermilk. Buttermilk is different from whole milk. Whole milk contains fat. The fat has been removed from buttermilk. The food value of buttermilk is not as great as that of whole milk. However, many people drink buttermilk because of its flavor.

Bacteria and Cheese Making. Another important food which depends upon bacteria is cheese. Without bacteria you could not have cheese. Cheese is made from milk. Consider cottage cheese, for example, which can be made at home. Sour milk is used to make cottage cheese. Milk left out of the ice-box or refrigerator will soon sour, because of the bacteria naturally present in milk. When the milk for cottage cheese is sour, it is placed in a cloth strainer. The liquid passes through the strainer, leaving curds. These curds are called cottage cheese. Thus, you can use natural bacteria to sour milk to make cheese.

All kinds of cheese are made of sour milk with or without cream, depending upon the kinds of cheese being made. Even in cheese factories the process is the same as the one used at home. It is said that there are about 400 different kinds of cheese made in factories all over this country at the present time.

Fermentation. Now there is only a certain kind of bacteria which will sour milk or cream. And in turning milk sour, these bacteria use only one of the elements of the milk. You recall from your study of foods that milk is made of many parts or elements. Some of the food elements in milk are fat, minerals, and vitamins. There is another element in the milk which you can taste if you drink it slowly enough. This element is sugar. It is the sugar in the milk that this certain kind of bacteria use for food.

When the bacteria break down the sugar in milk, the milk has a sour odor. When certain bacteria grow in a food, they are breaking down the sugar. As a result, the food no longer smells or tastes sweet. Sometimes we say that sour things have a sharp, acid taste. Some people like the sour, acid taste in foods. Two food substances with a sharp, acid taste are buttermilk and vinegar.

The process of breaking down the sugar in any food into acid by bacteria is called fermentation. Any fruit or vegetable that contains sugar may be fermented if a certain kind of bacteria is present. Wherever there is fermentation there is also the formation of an acid, and frequently gas, which is caused by the bacteria. The process of fermentation is used in making vinegar. It is also used in souring cream for churning, and in making cottage cheese.

Fermentation and Sauerkraut. Sauerkraut is produced by fermentation. The heads of cabbage are sliced through in thin slices. A large container, sometimes a barrel, is used to hold the cabbage. A layer of cabbage is put in, then a layer of salt. Layer after layer, cabbage and salt, are put in until the container is filled. It is then covered to keep out the

dirt, and left to stand for some time. Salt plays a very important role in the making of sauerkraut. The salt draws out most of the moisture from the cabbage. As the moisture is drawn out, liquid is formed. In this liquid the acid-forming bacteria grow. As these bacteria grow, they cause fermentation by using up the sugar in the cabbage. Fermentation in cabbage to make sauerkraut takes a much longer time than the souring of cream to make butter. The reason is that the sugar in the cabbage is not so easily reached as in the milk. It is packed away in the hard, thick leaves of the cabbage.

Fermentation in Making Pickles. Fermentation is used also in making pickles from cucumbers. The cucumbers are sliced and placed in a jar. Then salt is added to the sliced cucumbers to keep harmful bacteria from growing. The salt will also permit the useful bacteria to turn the sugar into acid and cause fermentation. It will take a long time for fermentation to be complete. As in the cabbage, the sugar is packed away in the cucumber and it will take some time for the bacteria to begin the breaking down process.

Fermentation and Fruits. Fermentation also may spoil some foods. This is particularly true of fruits. The bacteria which spoil fruit need not be harmful to man. Such bacteria merely produce in food chemical changes which man does not want.

Usefulness of Bacteria. You have learned that when bacteria have food and are kept under favorable conditions, they grow and multiply very fast. You have also learned that bacteria absorb food and produce various substances. These substances are useful in the making of butter, buttermilk, cottage and other kinds of cheese, sauerkraut, and pickles. The bacteria that cause milk to sour, that change the cabbage to sauerkraut, that decay dead animals and vegetable matter, all are examples of helpful and useful bacteria. These bacteria, while living on food substance, produce desirable changes. Thus it is that certain bacteria are helpful and useful to man.

Bacteria That Are Harmful

Communicable Diseases. Bacteria may affect your lives in a very harmful manner. You are going to learn how to protect yourselves against a harmful, invisible enemy.

Many of you may know about the diseases called *diphtheria, scarlet fever,* and *whooping cough.* They are diseases that children sometimes have. These diseases are called *catching diseases.* That is, they are passed from one person to another. Perhaps some of you have had measles. Measles is a disease that you catch from another person.

The scientific word which is used for the catching diseases, such as diphtheria, scarlet fever, and whooping cough, is *communicable.* Communicable, or catching diseases, are caused by germs. Germs are part of the invisible world. But *germ* and *catching* are not truly scientific words. *Bacteria* is the scientific word for one kind of germ. Bacteria can cause diseases such as diphtheria and whooping cough. Being sick with a communicable disease was one experience that you may have had with bacteria.

Tooth Decay. Another one of the experiences you have with bacteria has to do with teeth.

Tooth enamel, you recall, is the hard white outer covering of the tooth. The dentin is hard, bony material that makes up the main part of each tooth. The pulp is the soft, inner part which contains the blood vessels and nerves of the tooth. Sometimes rough spots occur in the enamel. Then food particles lodge in these spots and crevices, and bacteria decay the food and then the enamel. If not removed, the bacteria spread through to the dentin. They may even get into the pulp. When this happens to you, the tooth hurts. It would hurt because the decay has reached the nerves in the pulp. To relieve the pain, you would have the tooth extracted. It will have to be extracted by a dentist. How the bacteria got there and grew, you will learn later.

How Bacteria Were Discovered

The First Microscope. In 1675, in Delft, Holland, there lived a man whose name was Anton van Leeuwenhoek. The name is pronounced Lāy′-wĕn-hook′. During the day he sold cloth and neckwear. He measured the wine of the city wine cellar. He also surveyed land. But in his leisure time he was quite a different man. He had a hobby. He enjoyed making magnifying glasses and looking through them at all sorts of tiny things. The magnifying glasses of Leeuwenhoek's day were woefully weak so he tried to make better ones. In his spare time he made high powered lenses. That was his hobby, making lenses. Leeuwenhoek made the first microscope. His lenses were very good. They were as good as some of the lenses in our modern microscopes.

A Drop of Water. One day Leeuwenhoek put a drop of water under his lenses. To his surprise he saw tiny things moving about in the water. Because they were both tiny and moving, he called them "animalcules," which means tiny animals. He also made drawings of what he saw under his microscope.

The First Bacteria Seen by Man. What Leeuwenhoek was really looking at were bacteria, though he did not know it. According to Leeuwenhoek's drawings, bacteria grow in three forms. These three forms are rodlike, spherical, and spiral. Spiral means like a cork screw.

Thus did Anton van Leeuwenhoek, in his spare time, while seeking only to amuse himself, open up

an unknown, invisible world. Two hundred years later other men proved that bacteria are the cause of much trouble in your visible world. During these two hundred years, many scientists, doctors, and other learned men made experiments.

Linking Bacteria with Disease. Along about 1840, a few people began to suspect that some of these microscopic forms of life might have a harmful effect upon man. In 1854, the French chemist, Pasteur, proved that bacteria caused the spoilage of beer and wine. A little later, 1863, another Frenchman said he "believed that bacteria caused a disease in sheep." Not until 1876, exactly two hundred and one years after Leeuwenhoek first described bacteria, did any man actually prove that some kinds of bacteria can cause disease, not only in animals but in man.

The man who proved that some kinds of bacteria cause disease was a simple German country doctor named Robert Koch, pronounced Cōke. None of the great scientists of the time knew much about Koch. But like Leeuwenhoek, in his spare time between visits to his patients, as a hobby also, Koch studied and worked with a microscope. In his day people knew something about bacteria. They called bacteria by that name, but only a few suspected them of causing disease. And so, during his spare time, Koch set himself to the task of proving that bacteria really do cause disease. No one will ever know how many days and nights he worked and how many times he failed. But one day, in 1876, he walked into the laboratory of a great scientist of that time. He said to the scientist, "I know that bacteria cause disease, and I can prove it." He did prove it, and settled that question for all time. How he did it was really quite simple.

Proof That Bacteria Cause Anthrax. First, Koch took an animal which was suffering from a disease called anthrax, a condition well known to all farmers, doctors, and scientists. In the blood of these sick animals he showed to the scientist the bacteria which looked like little sticks and grew in long chains. Koch actually worked with sheep. But, just because he saw these stick-like bacteria did not mean that they necessarily caused disease.

Next, he took some of this blood containing this particular kind of bacteria, and put it into a sterile glass bottle. He mixed with it some food for the bacteria, and raised millions of them. He used the fluid from the eye of an ox for food for his bacteria. Again he examined drops of this fluid. He saw the same sticklike bacteria that he saw in the blood of the sick animal.

Then he said, "Now, since I have raised these bacteria from the blood of the sick animal, if they really cause anthrax, then I should be able to make well animals sick with anthrax by putting into them these bacteria I have raised in this bottle."

He did this, and the well animals became sick with anthrax. So you might think that he had proved that his bacteria caused disease. But he was not satisfied. One more step was necessary. He said again, "Since I put these bacteria into the well animal and made it sick, I should be able to find these same bacteria in the blood of this sick one." So he studied the blood of the sick animal and there they were. Then, he was satisfied. He had proved that one kind of bacteria cause anthrax in animals. It was only a short step further to prove that these bacteria also cause disease in people.

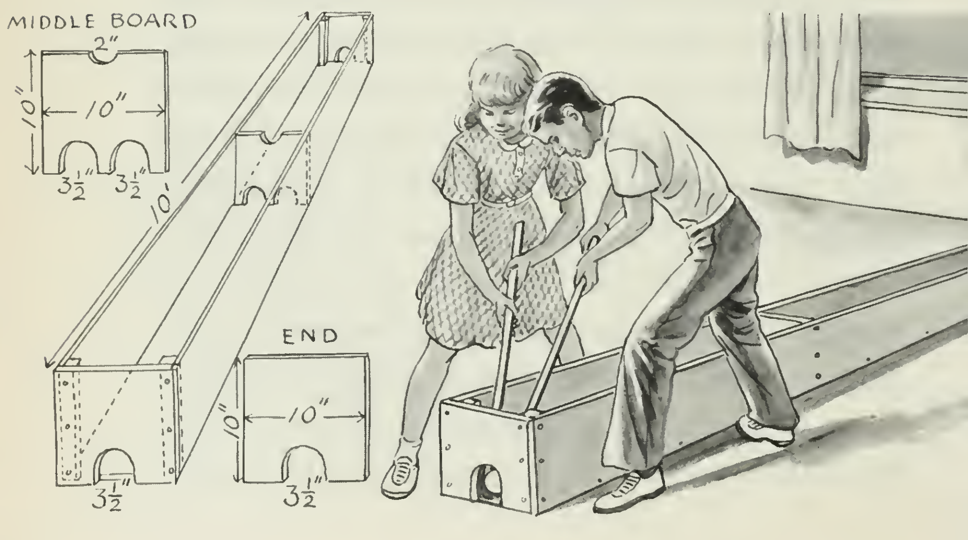
Activity for Health

Box Hockey. Hockey in the Box or Box Hockey is a good rainy day game. A certain kind of box is required to play this game.

Building the box is a good task for a rainy day. Playmates living near can help. You may need to ask your father's advice about a few things.

The box can be made of boards one inch thick and either 5 or 10 inches wide. If the 5 inch boards are used, it will take two to make each side.

As you see from the picture, the box has sides and ends. It has a board in the center. This board



divides the box into two equal parts. This center board should be made to fit tightly. The corners of the box should be made strong by putting in blocks. The boards of the box can be nailed or screwed to the blocks.

An opening about 3½ inches wide and 3 inches high should be cut at the center bottom at either end of the box. Two openings are cut in the middle board. In the top of the center board is an opening or a notch cut about 2 inches wide and 2 inches deep.

A yardstick, a stick of wood about the length of a yardstick, or an old baseball bat made shorter may be used for a hockey stick. A hard rubber ball, an old baseball, or even a croquet ball may be substituted for a regular hockey ball.

Because it is played indoors does not mean that it is a quiet, uninteresting game. It is also fun to watch others play.

Usually two play at one time, although four can play. The players stand facing each other at opposite sides of the box. Each player's goal is at the end of the box to his left. Each player tries to hit the ball through this goal with the stick.

The ball is placed in the notch at the top of the middle board. The two players place their sticks on the floor of the box on opposite sides of the center board. They raise the sticks and strike them together above the ball. The striking is done three times to a regular count. The striking takes place to these word signals, "Tap the floor, tap the sticks." These words are said three times. After the third time, each one tries to hit the ball forward. If the ball falls into the half of the box at the player's right, he must try to pass it through one of the holes in the center board into the section at his left. This gives him a chance to score. Of course, the other player is trying just as hard to keep the ball on his left side and to pass it through the opening at his end of the box.

If the ball is hit out of the box, it is put back into play by placing it on the floor of the box opposite the place where it left the box. The players tap their sticks above the ball again three times, repeating the same words. They continue playing as before.

One point is scored each time a player succeeds in passing the ball through the opening in the end of the box to his left. The player who first earns five points wins the game. Since the box has no bottom surface, it is placed for play on a table, on the ground, or on the floor. This is a good game for home and school. Adults and children may play and enjoy it together.

Things to Remember

1. Bacteria are invisible living plants.
2. In the presence of air or oxygen, bacteria will decay dead plants and animals.
3. In the process of decaying, bacteria break down the dead plant and animal substances into the simple food elements of which they were originally composed.
4. The fertility of soil depends upon the action of bacteria.
5. Every plant, as it grows, takes simple minerals out of the soil and puts them into the complex substance of its body and its fruit.
6. The corn plant gets the material to make starch, sugar, oil, and even some protein from the soil.
7. The work of bacteria is to replace in the soil the minerals that are taken out by the plants.
8. The simple minerals in the soil are nitrates, calcium, phosphates, and carbonates.
9. Some bacteria serve a very useful purpose in the preparation of certain foods.
10. In a butter-making factory all cream is pasteurized to destroy any harmful bacteria that might be in it.

11. The food value of buttermilk is not as great as that of whole milk.

12. When bacteria break down the sugar in milk, the milk has a sour taste and odor.

13. The process of breaking down the sugar in any food into acid by bacteria is called fermentation.

14. The substances made by bacteria are useful in the making of butter, buttermilk, cottage and other kinds of cheese, sauerkraut, and pickles.

15. Communicable diseases are caused by bacteria.

16. Bacteria cause tooth decay.

Study Exercises and Questions

1. What happens to dead plants and leaves during the winter?
2. In what way does the fertility of soil depend upon bacteria?
3. Name three diseases caused by harmful bacteria.
4. Who discovered the microscope?
5. For what is Robert Koch noted?
6. How does the plant get calcium, phosphorus, and nitrogen?
7. Why are the green plants of the visible world called builders?
8. Why are the bacteria plants of the invisible world called wreckers?
9. In what way does the dairyman make use of bacteria?
10. Be prepared to describe how butter is made.

11. How is cream, which is received from many places, made safe before it is used in butter or cheese?

12. What is one activity of helpful bacteria which may be harmful sometimes?

Suggested Activities

1. Find out how a compost pile is made. Prepare a report that could be given in class.

2. Set a glass of milk in a warm place where it is exposed to air. Note the changes that take place in appearance, taste, and odor. Explain what produces these changes.

3. Set a glass of sweet apple juice in a warm place. In time, note the mass of solid material that appears. This material contains bacteria which will change apple juice into vinegar. Write a description of the changing process.

4. Allow some kind of fruit to decay. Note the changes that take place, in firmness, odor, and appearance. Write an explanation of the cause of decay.

5. Find out what elements are contained in some commercial fertilizers. Make lists of these elements and compare them with the elements mentioned in the text as being necessary for plant growth.

Words to Master

bacteria	disposal	microscope
carbonates	fermentation	nitrates
communicable	fertile	invisible

SOME MEMBERS
GREATLY MAGNIFIED
OF THE INVISIBLE WORLD

CHAPTER VII

HOW BACTERIA GROW

Characteristics of Bacteria

Bacteria—Living Beings. You have just read about some of the important discoveries of the scientists Leeuwenhoek and Koch. Though these discoveries were nearly two hundred years apart in time, they really fitted together like parts of a picture puzzle. Leeuwenhoek's discovery of bacteria caused scientists of that day to ask many questions about the "animalcules," as they called them. To be sure they did look like tiny animals as they moved about on the slide under his newly made microscope. Watching them day after day, Leeuwenhoek saw many of them multiply and increase in numbers. Other scientists became interested, too, and they began asking questions of each other. What are bacteria? What makes them grow? How do they grow?

Now perhaps it is not possible for you, as a class, to study bacteria under a microscope. Nevertheless you can find the answer to these three questions without the help of the microscope. Because Leeuwenhoek had seen bacteria multiply, he knew they must be alive. Since bacteria are living things, they must belong in one of the two classes of all living things. All living things are either plants or animals. Most scientists say that bacteria are plants rather than animals.

Need for Food and Water. Food, water, air, and warmth are necessary for the growth of living things. In this discussion, you will consider two of these necessary conditions, food and water. Plants use minerals for food. These minerals have been dissolved in the water of the soil. This mineral food is taken up through the roots of the plant. Plant food must always be in liquid form in order for plants to use it.

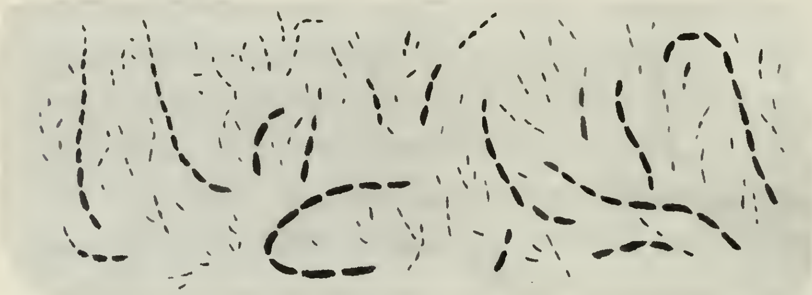
Animals eat many things for their food, among them plants and other animals. The food animals eat may be in either liquid form or solid form. This depends on what the animals want. These are two facts to keep in mind. Plants can use only liquid food. Animals use both liquid and solid foods. Since bacteria cannot produce their own food, they depend upon other plants and upon animals for food.

Microscopic in Size. As you have read, bacteria are the simplest forms of life. They are tiny one-celled organisms. As you know, bacteria are too small to be seen with the naked eye and can be seen only with the aid of a microscope. Therefore it is said that bacteria are microscopic. This fact, as you learned in Chapter Six, was discovered by the scientist, Leeuwenhoek.

Colorless Plants. As scientists looked at bacteria through their microscopes, they discovered another fact, that bacteria have no color. They have no chlorophyll as visible plants do. Therefore, it is said that bacteria are colorless plants.

Aerobic and Anaerobic Bacteria. When bacteria are well supplied with food, water, air, and warmth, they will grow and increase in numbers very rapidly. Some bacteria require air for growth. These are called aerobic bacteria. Some bacteria can grow without the presence of air. These are called anaerobic bacteria.

Growth by Division into Parts. Bacteria multiply by dividing in one, two, or three directions. This sounds rather complicated but it really is quite simple. When growing conditions are just right, a



single one of the bacteria, which is called a bacterium, will grow larger and longer, until it cannot increase in size any more. Then it will break into two parts. Look at a whole piece of chalk such as you have in your class room. The chalk represents the way a single bacterium would look under a microscope. As a matter of fact, there is a family of bacteria that are shaped just like a piece of chalk.

Break the piece of chalk into two even parts. Imagine these are real bacteria. With all the things necessary for their growth right at hand, each one will continue to grow. Each one will grow until it is as big as the original bacterium from which it came. Then, each one of these will break into two parts. They usually split crosswise. This process of growing larger and splitting into two parts may take place about every fifteen minutes. This will continue as long as the conditions for growth are just right.

Growing Bacteria

How to Observe the Growth of Bacteria. It may seem impossible to be able to catch bacteria which you cannot see, feed them, and make them multiply and increase. But it can be done.

First, if you can catch a single bacterium, you must give it food, moisture, air, and warmth to make it grow. Second, after doing this you need some way of making a mass of bacteria visible to your unaided eyes.

Imagine your teacher has some sand on her desk. Suppose the teacher should place a single grain of sand on a piece of paper. The pupils in the back rows could not see the single grain of sand. It would be invisible to them, just as a single bacterium is invisible to all people.

Let this grain of sand represent a single invisible bacterium. Now if you give this single bacterium food, water, air, and warmth, it will grow and di-

vide and become two bacteria in fifteen minutes. The teacher will now drop another grain of sand on the paper. In the next fifteen minutes the two new bacteria will grow and divide. Then there will be four bacteria. Your teacher adds two grains of sand.

If she continues dropping grains of sand, as though she were putting on the correct number of bacteria for each fifteen minutes, she builds a pile of sand which everyone can see. You have seen a single invisible grain of sand grow into a visible pile of sand. Pupils in the back seats cannot see the single sand grains which make up the pile, but they can see the whole pile.

Rate of Growth of Bacteria. Now, that is exactly the way you can make a single invisible bacterium grow into a visible pile of bacteria. In forty-eight to seventy-two hours of growth it will have become piles of bacteria big enough to see. The following table shows the rate at which bacteria increase in numbers under favorable conditions:

In fifteen minutes . .	1 bacterium becomes 2 bacteria
In a half hour	2 bacteria become 4 bacteria
In forty-five minutes	4 bacteria become 8 bacteria
In one hour	8 bacteria become 16 bacteria

A pile of bacteria is called a colony. When colonies of bacteria are raised, you do not see individual bacteria, but you see the colonies of bacteria.

A Petri Dish. It is a simple matter to feed and raise bacteria. To accomplish this successfully, some special materials must be used. First, a Petri dish is necessary. This dish is named for the scientist, Petri, who first used this method of capturing and growing single bacteria. It is a shallow dish of thin glass with a loosely fitting, overlapping cover. In this dish is placed some special food material for growing bacteria. The food material in the dish is a jelly-like substance. This substance, composed of beef-broth, is a protein food called *peptone,* and a solidifying substance called *agar-agar.* This food material is a powder, much like jello. Water is added to the powder and the mixture boiled and then the liquid is poured into the dish where it hardens just as jello hardens. It feels and sets much as jello does, too. Jello is food you like. This is a food that bacteria like.

Where to Get a Bacterium. Now you are ready to do the impossible—catch an invisible bacterium and feed it. Where will you get your bacteria and how will you get them into the dish? There are bacteria in your room. They are all about you—in the air, on the desk, on your book, and on your own fingers. If the cover of the dish is taken off and the sticky surface of the food material exposed to the air, bacteria will drop on the surface of the food in the dish. They will be caught on the spot where they fall and start to grow. Making finger prints on the surface of the food material would also capture bacteria. The dish should then be covered and put away in a dark, warm place for about three days. During that period colonies of bacteria will grow in the Petri dish.

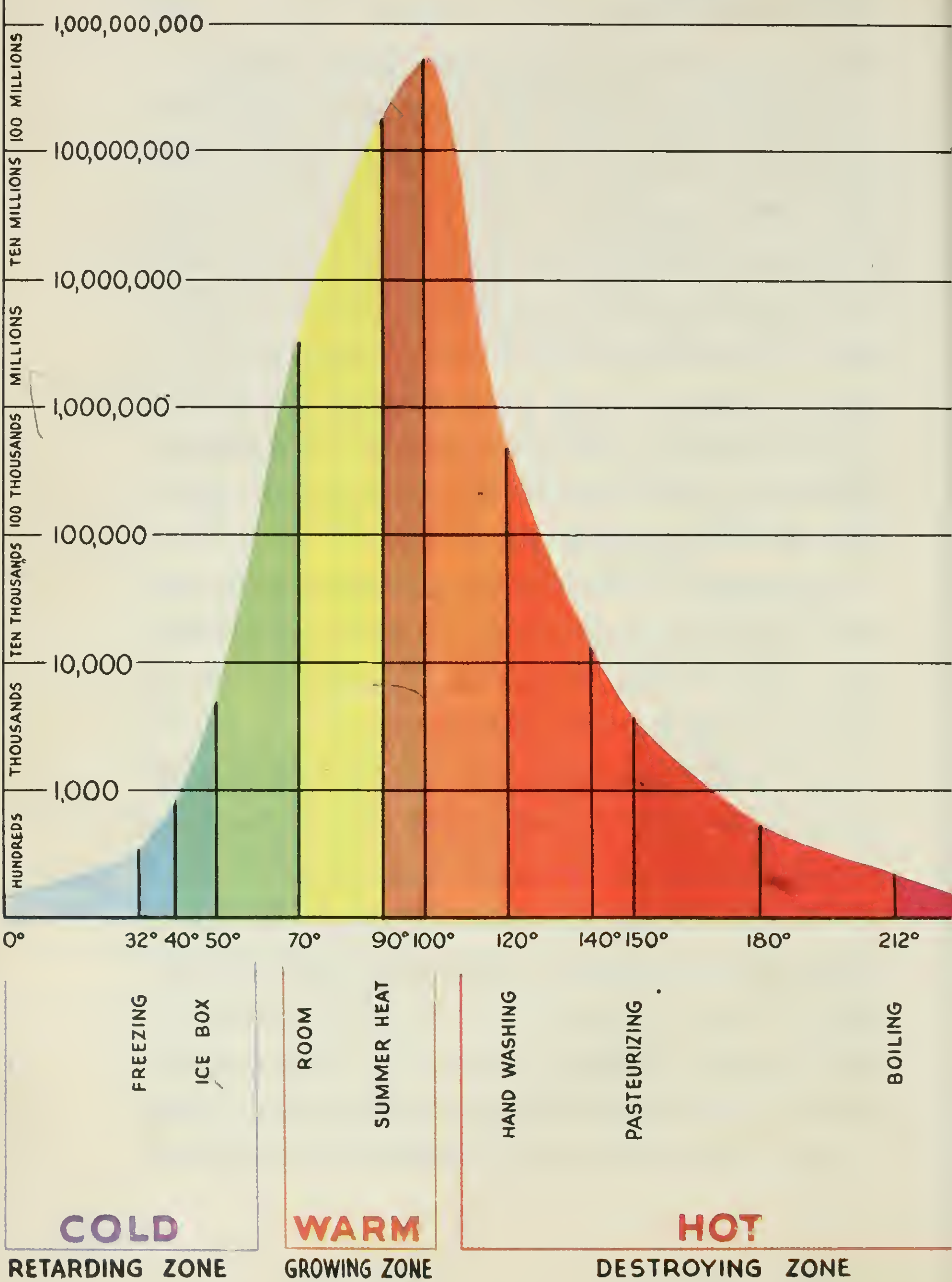
The Effect of Temperature upon Bacteria

Comparison of Bacteria and Visible Plants. You learned previously that bacteria are plants. You know that plants grow best when they get plenty of warmth from the sun. Bacteria grow best when it is warm, too. When it gets cold, and the temperature is low, all plants do not die. Some plants remain as they are until warm weather returns. So it is with bacteria. Some of them die when the temperature around them is very low; others survive until the temperature rises.

Temperature and Bacteria Growth Graph. You will now learn at what rate bacteria grow or die as a result of temperature changes. The graph on the next page will be helpful to you.

Notice the figures across the bottom of the graph. These show significant temperatures ranging from zero degrees on the left to 240 degrees on the right. Now notice the figures up the left side of the graph. These figures represent numbers of bacteria which, under certain conditions, may grow in any suitable food material. Notice how rapidly these numbers increase. This graph is drawn on a graduated scale to show the tremendous difference in growth at

TEMPERATURE AND BACTERIA GROWTH GRAPH



different temperatures. For example, from 0° to 40°, the numbers of bacteria that live are in the hundreds. The first bar, therefore, measures by hundreds—1 to 10 hundreds. But at 50° the live bacteria number between five and six thousand. Therefore, the second bar measures by thousands—to 10 thousand, and so on. At 140° the number is in the tens of thousands; at 120° the number is in the hundreds of thousands; at 70° the number is in the millions; and at 90° and 100° the numbers are in the hundreds of millions.

This is really a growth graph of bacteria. The graph line represents the growth of bacteria. It tells a very interesting story. Study it enough to understand it.

Low Temperatures and Bacteria. The first temperature shown in the graph is zero. When an outdoor thermometer reads zero degrees, the weather is very cold. The next temperature reading on the graph is 32 degrees. That is the temperature at which water freezes. The next two readings, 40 and 50 degrees, may be found in a very important place in most kitchens. You find these temperatures in the refrigerator or ice box.

Now study the graph curve more carefully. At zero degrees, about two hundred bacteria are represented as being alive. As the temperature rises from zero to 32 degrees there is a slight increase in the number of live bacteria. If you were to lay a ruler on a horizontal line from the 32 degree point on the curve to the number scale on the left side of the graph, the graph reading would be about five hundred bacteria. So, even at this cold temperature, a few more bacteria have grown than were present at 0° F.

The icebox temperature is 40 to 50°. The reading for this temperature block is 900 to 5500. This means that more bacteria can grow between 40° and 50° F. than can grow between zero and 32 degrees F. The reason is that 40 to 50° is much warmer than zero to 32° F.

The Growing Zone of Warmth. The first reading in this zone is 70 degrees, room temperature. You have felt the next temperature, 90°, on hot days in the summer. This zone extends through 100° F.

Look at room temperature on the graph. Note that the number of bacteria is approximately seven million. As an example, to see what these tempera-

tures and numbers really mean, suppose you had a quart of milk on your back doorstep. If you put it in the icebox immediately, the milk will keep fresh longer than if you leave it on the kitchen table at room temperature. If you left it on the doorstep in the sun where the temperature might easily be 90° F., the bacteria would increase rapidly and sour the milk quickly.

The Destroying Zone. As you pass 100° F. you enter the zone where heat no longer helps growth but causes death. The chart shows that large numbers of bacteria have been killed at this temperature. One hundred twenty degrees is the highest or maximum temperature of water that your hands can stand while washing them.

The 120° reading tells an important fact. It tells you that washing your hands in very warm water kills many of the bacteria which may have been picked up. That is why you should wash your hands with warm water and soap as often as necessary—especially before handling food.

It also tells you why it is a good practice to wash any cuts or scratches before treating them. The hot water kills some of the harmful bacteria and thus leaves fewer for the antiseptic to destroy or to prevent from growing.

Pasteurizing. The next temperature, 140° to 150°, is familiar to all of you. The process of pasteurization is carried on at temperatures between

140 and 150 degrees. Even at this temperature some harmless bacteria survive, but all harmful bacteria can be killed at this temperature. The word pasteurization appears on the chart.

The next temperature, 180 degrees, marks a place where many bacteria are killed. It is not used in any particular process, however.

How Time Helps. You have learned that bacteria grow rapidly with increases of temperature. Low temperatures slow up the rate of growth of bacteria. High temperatures kill bacteria. In all these functions time plays an important part. The pasteurization temperature must be maintained a half hour to destroy all harmful bacteria.

Boiling and Sterilizing. The next temperature, 212°, is one with which all of you are familiar, also. Water boils at 212 degrees. At this temperature only a few hardy bacteria can exist. Time is important in connection with boiling to kill bacteria, also. Boiling an hour will destroy more organisms than will boiling for five or ten minutes.

At 240 degrees, all bacteria are killed. The word sterilizing describes the process which absolutely destroys all bacteria. Doctors use this process to kill all bacteria on their instruments. Your school nurse uses it too, right in your school dispensary. The word *sterilizing* is written below the 240 degree temperature. A temperature of 240° held for twenty minutes or longer will absolutely kill all bacteria. To obtain temperatures over 212° F., the heating must be done in closed containers to develop steam pressure. Sterilization, that is absolute killing of all bacteria, is rarely accomplished at 240° in less than twenty minutes. Since all the bacteria are dead at 240° F., that is the end of the growth graph.

How Temperatures Control Bacteria Growth. Now study the growth and temperature graph to see how temperatures do control the growth of bacteria in food. The figures in the lefthand column are very important ones. They tell how rapidly bacteria increase in numbers when growing conditions are just right.

The growth line of bacteria from zero degrees to 50° shows that although increase is very slow, there is some growth even at these low temperatures. Low temperatures seem to slow up or hold back the growth of bacteria. Therefore, it might be said that zero through 50° is the retarding zone. The growth line from 50° to 100° at the top of the curve shows that bacteria have increased in numbers between these temperatures six thousand to almost one billion. With an increase in temperature, up to a certain point, you get a great increase in the numbers of bacteria. This means that the warmer the temperature, to that certain point, the faster bacteria grow. That certain point, as shown in the chart, is 100° F. The temperatures from 50° through 100° make up the warm growing zone.

Now trace the curve from the top down to 240° F. The end of the line at 240° represents zero, or no bacteria. This line shows that bacteria have not increased in numbers between 100° and 240° F. The line shows that bacteria have decreased in numbers between 100° and 240° F. This side of the curve does not represent growth at all. It represents death. When the temperature goes beyond 100° F., it becomes so hot that many bacteria are killed. Even so, some bacteria can stand a lot of heat. A temperature of 240° is necessary to kill absolutely all bacteria. This range in temperature might then be called the destroying zone.

Temperature has a decided effect on bacteria. Warmth, moisture, and darkness help them to multiply very rapidly. Cold, as in refrigeration, prevents or slows up bacterial growth. Sunlight, heat, or dryness may kill bacteria. Bacteria are present in large numbers in the soil, in water, and in the dust of the air, but most of them are harmless.

Activity for Health

Streets and Alleys. The fight of the body against bacteria goes on constantly. Playing outdoors is one way you can fortify your body against disease and sickness caused sometimes by bacteria.

Playing vigorous games strengthens your body and protects you from possible illnesses which may result from the presence of destructive bacteria in the blood.

Playing outdoors in the fresh air carries oxygen to all parts of the body. A healthy body helps in the battle to destroy unwelcome bacteria.

Tag games are very old. They are popular because they are lively and vigorous. They require quick thinking.

Streets and Alleys is a tag game. Many can play this game at one time. When you play, you are arranged in the position that diagram (a) shows.

```
          x--x--x--x--x--x                          x  x  x  x  x  x
                                          "Face     |  |  |  |  |  |
          x--x--x--x--x--x                 Right"   x  x  x  x  x  x
          x--x--x--x--x--x  O                       |  |  |  |  |  |
Tagger T  x--x--x--x--x--x  Pupil                   x  x  x  x  x  x
                            Leader                  | R|  |  |T |  |
          x--x--x--x--x--x                          x  x  x  x  x  x
          x--x--x--x--x--x                          |  |  |  |  |  |
             R  runner                              x  x  x  x  x  x

               (a)                                        (b)
```

There should be an even number of players in each line. All players face the same way. Players clasp hands to make their line unbroken. Players stand as far apart as they can and still clasp hands with the next players in line. Lines of players should be spaced about four feet apart. The space between rows then allows a tagger and a runner space to run safely. Each space, as the name of the game indicates, is supposed to be a street or a thoroughfare where traffic moves. The tagger and the runner are the traffic. The tagger tries to catch the runner as both run through the streets and alleys.

The leader of the game stands safely out of the way. He stands where he can see what is happening. He calls "Face to the right!" or "Face to the left!" This is the time when you need to think fast. When directions are called, drop hands and turn quickly. Be careful not to step forward or backward. As soon as players have turned, join hands again quickly to form another street. Now the streets and alleys run in a different direction. See diagram (b). If first streets and alleys ran north and south, the new thoroughfares will run east and west.

Perhaps the tagger was only the span of three players behind the runner before you changed position. But now there are three rows of players between the tagger and runner. They are in different streets. This helps the runner to get away from the tagger. The players who represent the streets are helping the runner.

The tagger is not permitted to reach across the clasped hands to tag the runner. The tagger has to change his course and pursue the runner through a different street.

A good leader calls the signals carefully and clearly. He sometimes calls them to keep the runner from being tagged. He may sometimes call the signals to help the tagger catch and tag the runner.

If it takes too long a time for a tagger to catch the runner, the leader stops the game. Two different players are chosen. This is a good plan because it gives every player a chance to be tagger and runner. Everyone prefers running to standing still.

This game requires quick thinking and good judgment. It is necessary to be alert to be able to turn in the right direction when the leader calls the signals. You could not play the game safely without the lines or streets. This game is a favorite because it allows everyone an opportunity to be active.

This game gives you practice in running. Running is good vigorous exercise. It develops strong leg muscles. Inactive muscles become flabby and weak. Properly developed leg muscles are capable of supporting the weight of the body. When you run, you are carrying the body along with you.

Things to Remember

1. Plants use only liquid food and animals use both liquid and solid foods.

2. Bacteria are microscopic, colorless, one-celled organisms.

3. When bacteria are well supplied with food, water, air, and warmth, they grow and increase in numbers rapidly.

4. Bacteria increase in numbers by growing and dividing into parts.

5. Men have been experimenting a hundred years to find the best weapons with which to destroy harmful bacteria.

6. Bacteria grow and increase very slowly in temperatures from 0° to 50° Fahrenheit.

7. Temperatures from 50° to 100° are the ones in which bacteria grow best and increase most rapidly.

8. Temperatures of 140° to 150° are pasteurization heat.

9. Two hundred twelve degrees Fahrenheit is the temperature at which water boils. At this temperature only a few hardy bacteria can exist.

10. Sterilizing, the process which kills all bacteria, can be accomplished at 240° in twenty minutes.

11. Bacteria are present in large numbers in the soil, in water, and in the dust of the air, but most of them are harmless.

Study Exercises and Questions

1. Write a list of the conditions necessary for the growth of bacteria.

2. Under proper conditions how long does it take one bacterium to become two; sixteen to become thirty-two?

3. What do plants use for food?
4. What are three characteristics of bacteria?
5. What is the difference between aerobic bacteria and anaerobic bacteria?
6. How do bacteria grow and increase in numbers?
7. What is a Petri dish?
8. What effect does temperature have on bacteria?
9. Within what temperatures do bacteria grow rapidly?
10. What happens at each of these temperatures: 140°, 150°, 180°, 212°, 240°?
11. (a) Of what importance is the temperature reading, 120°F.? (b) What use can you make of this information?
12. Where are bacteria found?

Suggested Activities

The following are interesting experiments for you to perform at home.

1. Take two pint jars, one with water in it, and an empty one. Then take two small pieces of celery—

not over two inches long. Place one piece of celery in each jar. Screw the top on the jar containing the water. Be sure to remember how clear the water was when the celery was put into the jar. Once a week take the lid off the jar and smell the water. See if you can detect any odor. You may wish to keep a record of what happens to these two pieces of celery. Your teacher will show you how to arrange a page in your notebook to record the changes which take place in the celery and in the water. Observe the progress of the celery experiment in both jars for several weeks. Look for cloudiness in water. Notice the odor of decay. Notice appearance of celery itself. Note the changes that take place. These changes will be caused by bacteria.

2. This experiment will show some of the conditions favorable for the growth of bacteria, and some conditions which are unfavorable.

Take two small glasses and one half pint of fresh, sweet milk. Fill each glass about half full of milk. Put one glass in a warm, dark place. Put the other in the refrigerator or ice-box, or in the coolest place available. Inspect each glass regularly and keep a record as follows:

Appearance and Odor of Milk After	Glass Number 1 Warm Dark Place	Glass Number 2 Cold Place
1 day		
2 days		
3 days		
4 days		

Note under what conditions the milk soured first. Note what condition is favorable for bacterial growth. Note what condition is unfavorable.

3. This is an experiment to show the effect of moisture and dryness upon the growth of bacteria.

Take four dried beans such as are used for baking or boiling, lima, kidney, pea beans, or any other. Also have two small glass dishes or test tubes.

Crush or pound the beans into small pieces. In the first dish, or test tube, put half the crushed beans and no water. Put the other half of the crushed beans in the second dish or test tube and fill half full of water. Cover and put both dishes or tubes in a warm, dark place.

Examine both dishes or tubes in two to four days. Note whether the water in the dish or tube has changed in appearance. Note whether there is any odor about the water that it did not have when fresh. Explain what produced the odor. Notice whether any change has taken place in the beans in the dish or tube without water. Notice whether there is any odor in the dry dish or tube. Explain how the water aided the growth of bacteria. Be ready to tell what you conclude is the effect of moisture on bacterial growth. What is the effect of dryness on bacterial growth?

Words to Master

bacterium	microscopic	scientists
complicated	pasteurization	solidifying
dissolved	reproduce	temperature


DRYING MEAT—AN EARLY METHOD
OF BACTERIA CONTROL

CHAPTER VIII

HOW HARMFUL BACTERIA ARE CONTROLLED

Harmful Bacteria and Food

Bacteria at Work. You have learned that bacteria grow very rapidly in soil and in water. As they grow, they decay any dead thing that happens to be in the soil or water. When anything decays, it is changed in looks and form. Decay really means the breaking down of any complex substance into simple substances. The bacteria break down vegetables, fruits, and dead animals into the simple substances of which they were first made. This breaking down of dead things in the soil is useful to you.

Now, these same soil and water bacteria get into your homes. They also get on and in your foods. They spoil your food. They cause meat to decay; they cause eggs to go stale; they cause fish to spoil. With the help of some of their relatives, they cause vegetables and fruits to rot. Unless your mother is particularly careful when she puts up tomatoes and other vegetables, bacteria will spoil some of the foods that she cans.

When bacteria spoil food in your home, they are not doing anything different from what they do when they are in the soil or water outdoors. They are breaking down complex plant and animal materials into simpler substances. But when this process takes place in food, it is harmful to you. It is harmful because it spoils food that you would eat. Because of this, there is need for war against bacteria. They must be destroyed because they destroy something you want. In previous lessons you studied methods used to protect your food from bacteria. Now you are going to turn your attention to another field—the warfare that must be carried on between man and bacteria. This warfare is not outdoors or in your homes, but in yourselves.

The Need for Control of Bacteria. You do not want bacteria to destroy your food. So some methods are necessary to prevent this destructive work. It is only within the last hundred years that man has known anything about the values and dangers of bacteria. During that time, he has experimented over and over again to find the best weapons with which to destroy harmful bacteria, before they could destroy his food and himself. In order to be able to destroy bacteria, man had first to learn under what conditions bacteria grow best.

You learned the effects of temperature on the growth of bacteria. Controlling the temperatures in which food is kept is man's most useful method in controlling the growth of bacteria in food. Look again at the temperature chart on page 168. Note that bacteria grow very slowly at temperatures between 0° and 32° F. There is but a slight increase in the number of bacteria in that zone of temperature. At 240° F. no bacteria can survive. This is important knowledge for man to use in his battle with bacteria. He makes use of this knowledge to preserve or save food.

Nature is very generous in the production of man's food. But, unfortunately for man, this bountiful supply of all the different foods is ready for use within a comparatively short period of time. If all the food is not used immediately, it might spoil. For centuries, man's life was divided into periods of either feast or famine. The feasting time occurred when celebrating a plentiful harvest. But after the feast was over, man's problem was how to save as much as possible of this extra food for future use.

There are several ways in which to preserve or save food. These are salting, smoking, drying, canning, pasteurization, refrigeration, and quick freezing. You will now learn about these methods of preserving food.

There is no certain knowledge of how man happened to begin to preserve food. It is known that drying, salting, and smoking were man's first attempts at preserving food for future use. You may have read something about this in your history and geography books. People in other lands and the

pioneers in our own country smoked, dried, and salted their extra meats, fruits, and vegetables in order to provide food during the winter months. In those early days men did not know anything about bacteria as a cause of food spoilage. They knew only that foods treated by salting, drying, and smoking would keep.

Controlling Bacteria by Salting, Smoking, and Drying

Salting Foods. Salt has a very decided effect on food. If you were to cut a hole in a raw vegetable or fruit and put a teaspoon of salt into the hole, then let it stand for a while, the hole would contain some water. The water comes from the vegetable or fruit. The salt would have drawn the water out of the moist vegetable or fruit substance. If you sprinkle salt on radishes or raw carrots, water collects quickly on their surfaces.

If there are bacteria in the vegetables or the fruits, when the water is drawn out of the food, it is drawn out of the bacteria, too. Water is necessary for bacteria to live. All bacteria must have moisture in order to live and grow. Therefore, when

water is removed from their bodies, the bacteria die. These are bacteria which otherwise would spoil the food upon which they are growing.

Therefore, salting, which takes some of the moisture out of food, also kills some of the bacteria present. Thus the food may be preserved for future use by salting. Many kinds of bacteria are killed by salting, but there are some which can survive. The ones which are killed are usually the harmful kind.

The Kinds of Foods That Are Salted. There are many foods which are salted and thus kept for future use. Codfish is one kind of salted fish which is probably familiar to you. Codfish as it is bought in boxes or tins has been preserved by first being salted and then dried. The salt draws the moisture from the fish, just as it does from vegetables and fruit.

Salted and dried fish can be packed and shipped long distances with no danger from spoiling. Mackerel and herring are other fish which are salted before being shipped to distant markets. Other foods which are sometimes salted in order to preserve them are pork and beef. Salting food kills some bacteria and prevents the growth of others.

Smoking Foods. Some foods go through a second process to preserve it. This second process is known as smoking. Meat is one food which is not only salted, but in some instances smoked also in being made ready for market. Smoking meat also improves the flavor. Wood smoke, which is usually used for meat smoking, contains certain chemicals which are antiseptic. They prevent the growth of some bacteria. However, smoking is usually used in connection with salting.

The salting process which precedes the smoking destroys most of the bacteria which might cause the meat to spoil. Smoking, because the smoke is fairly hot, dries the surface of any meat. This is another way that smoking prevents the growth of bacteria on the outside of meat.

You probably have read stories in your readers of pioneer children helping in the smokehouse. The place where meats were smoked after being salted was called the smokehouse. The pioneers may not have known the scientific reason for all this extra work to preserve foods.

Kinds of Smoked Foods. Smoked meats you commonly use in your home are smoked shoulder, ham,

bacon, and smoked sausages. Fish can be and are smoked in the same manner. Some kinds of cheese are also smoked.

Drying Foods. There are other foods which can be preserved for future use by the simple process of drying. Another name for drying is dehydration. This process also removes water from the foods. Without the water, the bacteria cannot live. Therefore, the bacteria are controlled. Drying, too, is a very old method. It has been used by man for hundreds of years.

Fruits and vegetables may be spread out on racks to dry. Sunshine and the fresh air remove the moisture from the foods. Or, fruits, vegetables, and meats may be dried by artificial heat. These are two methods used to dry foods. Today, in modern factories, great ovens are used to dry foods.

Kinds of Foods That Are Dried. Some foods that are dried in order to preserve them are peas, beans, corn, prunes, raisins, apples, peaches, pears, apricots, potatoes, meat, and even milk and eggs

When these fruits are dried, they can be shipped long distances and used when needed. Thus the food is saved for man's use.

Codfish is sometimes dried after being salted. This is especially the case when the fish is to be sold whole rather than in packages. After the codfish have been well salted, they are placed outdoors in drying racks. All the moisture which is drawn out by the salt evaporates during the drying process. This leaves the fish both dry and salted. There is very small chance, if any, for bacteria to grow and destroy the fish.

The business of salting, smoking, and drying foods is an important industry. It amounts to several millions of dollars each year. It is a big industry and gives employment to thousands of people. These people are engaged in the work of destroying certain kinds of bacteria before the bacteria destroy the food.

Preparation of Dried Foods for Eating. Something needs to be done to corn, peas, and beans which are dried to preserve them, before they can be used as food. They need to have the lost water restored in them. This is usually done by soaking them in water two or three hours or over night. The length of soaking depends upon the kind of food being used.

Controlling Bacteria by Canning

The Purpose of Canning. Many of you have watched your mothers can certain kinds of food.

You probably remember many of the things your mother did when canning. The purpose of canning food is to destroy bacteria before they destroy the food. Everything done during the canning process helps to get rid of bacteria on or in the food.

There are four major steps in the canning process. The first step is preparing the food. The second step is sterilizing the containers. The third step is sterilizing the food. The fourth and final step is sealing containers tight.

Preparation of Food for Canning. You will begin with the first step—preparing the food. In getting some fruits or vegetables ready for canning, the first thing to do is wash them. Washing removes some of the bacteria that may be on the outside of the fruit or vegetables. Then the fruit or vegetables may be peeled. Many bacteria are removed entirely with peeling. Washing and peeling then are the first steps for eliminating bacteria in the canning process.

Sterilizing the Cans. The second step in the canning process is sterilizing the containers, the glasses, jars, or bottles that are being used. Again refer to the temperature chart on page 168. Note at which temperature no bacteria can survive. That is the temperature at which sterilization takes place. Sterilizing the containers destroys the bacteria on or in them. This is done by boiling the containers in hot water for an hour or more. This, then, is the second step for destroying bacteria in the canning process.

Sterilizing the Food. The third step in the canning process is sterilizing the food. There are two ways of sterilizing food in canning. One way is to cook the food first, then to put the hot food into the glasses or jars, completely seal them, and then to let the food cool. This is called the open-kettle or hot-pack method. The other way is to put the washed food into the jars first, to partially seal them, then to heat them to a high temperature for a long time. This is called the cold-pack method. In the latter method the jars are heated in a water bath, a pressure cooker, a steamer, or an oven.

When food is held at a temperature of 240° F. for some time, all bacteria are killed. When all bacteria on food are killed, the food will not spoil. That is, it will not spoil as long as bacteria are kept out of the containers.

Sealing the Containers. That brings you to the last and fourth step in the canning process—sealing containers air tight. This may be done by using one of the new self-sealing covers. Canners need to be very particular about the covers on the jars to be sure they will keep out the air. This is important because bacteria from the air may get into the jar after it has been sterilized. If this happens, all the work of preserving the food will be undone.

Pasteurization. Louis Pasteur, the French scientist, who helped to prove that disease is spread by bacteria, also invented the food preserving process, pasteurization. In this process the food is heated to about 145° F. and kept at that temperature for at least thirty minutes. Then the food is cooled quickly to between 40° and 50° and is kept cold until it is used. Pasteurization is most commonly used to process milk and cheese. But sometimes other foods are pasteurized, too.

Controlling Bacteria by Refrigeration

Home Iceboxes, Refrigerators. Another method of preserving food is by refrigeration. Look at your temperature chart again on page 168. Notice that between 0° and 32° F. bacteria grow very little. But as the temperature goes up, bacteria begin to grow more and more rapidly. At some point above 50° F., a few kinds of bacteria may begin to grow very fast in certain foods. Therefore, those foods need to be put where this growth cannot be started. This is where the icebox or refrigerator comes in handy. Food will keep fresh and ready for use in the icebox. The temperature of most iceboxes and refrigerators is between 40° and 50° F.

Refrigeration in Markets and Stores. There are many other places where refrigerators are used to keep foods fresh. Meat markets and grocery stores keep foods in very large iceboxes. Some are as large as rooms in your house. That is where the grocer keeps the milk, butter, cheese, and the meat. There are huge coils inside the case that keep it cold.

Refrigerator Trucks and Railroad Cars. You often see trucks carrying milk from the country to the dairies. These trucks have large tanks on them. The tanks on the milk trucks are made exactly like the thermos or vacuum bottle you may have used. These tanks are glass lined and can keep milk at a low temperature for several hours.

The railroads do everything possible to furnish you with fresh fruits and vegetables. Refrigerator cars are built like huge iceboxes and attached to a fast freight train. These fast trains bring you fresh fruits and vegetables from distant farms all winter long. The foods in these cars stay fresh because the low temperature in the cars stops the growth of bacteria.

Quick Freezing Process. Within the last few years, men working on this problem of winning the battle for food against bacteria have discovered a new process of refrigerating foods. This is done by quick freezing foods and keeping them frozen until they are needed. Some of you have probably eaten frozen foods such as fruits, vegetables, and meats. This process is a new and better one of keeping the food fresh. It is done by quickly lowering the temperature to about 20° below zero and holding it at that point for some time.

Sterilizing the Food for Freezing. Read again the four steps in the canning process. In the canning process, step three is sterilizing the food by cooking. For freezing, foods are not cooked. But they are put through a process called blanching. The food is just dipped in very hot water and taken right out. This does, of course, kill off many bacteria on the outside of the food. The freezing process, however, is what destroys most of the bacteria. The freezing is done at a temperature of 20° below zero and this temperature is held for thirty to sixty minutes. The solidly frozen packages are then kept in a freezing temperature until you buy them. In temperature as low as that, very few bacteria can even begin to grow.

The following table shows you at what temperature some of the foods are processed or stored.

	Processed	Stored
"Quick Frozen"	—20° F.	
Pasteurized Milk	145° F.	
Canned evaporated milk	240° F.	
Canned peas or any canned vegetable	240° F.	
Cold storage poultry		0° to 5° F.
Cold storage eggs and meat		32° F.
Butter and Lard		32° F.
Fresh fruits, vegetables		32° F.

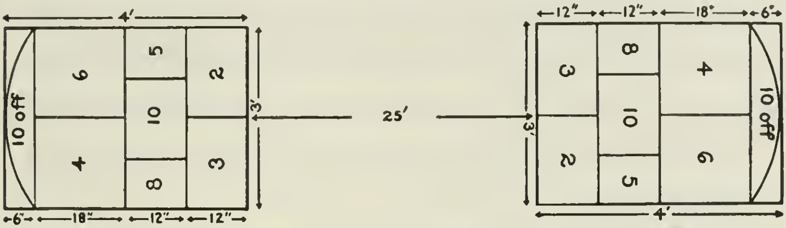
Activity for Health

Shuffleboard. Shuffleboard is a popular game enjoyed by young and old alike. It can mean fun for the entire family. It is played on the floor, or any smooth surface where the court can be drawn clearly. The court is the space for play. There are different kinds and sizes of courts, planned for special games. Special equipment is needed to play the game. This equipment can be bought or it can be made at home.

The correct names for the materials used are *disks* and *cues*. The disk is a round, light piece of wood. The cue is the handle, the head of which is shaped to fit the disk. The disk is pushed by the handle or cue to a certain numbered spot on the court. The disks and cues are the equipment that you can make.

The cue looks somewhat like a small shovel.

The game is played by two teams of two players each. It can be played on the sidewalk, porch, on the floor of a recreation room, or the driveway to the garage. It can be played on any flat, smooth, surface. Each team has three of the wooden disks.



The court is marked off into two identical end sections separated by 25 feet of space. One player from each team stands behind the space marked "10 off" at either end. The first player pushes one of the disks toward the opposite end trying to push it just hard enough but not too hard to stop on a high number.

The player on the opposite team has the next turn to push. He also tries to place his disk on a high number in the opposite court. This goes on until each player has had three turns because each player has three disks to push.

There is need for strategy in this game. Strategy is another word for skill. Each player, when he pushes the disk, tries hard to push the opponent's disk off the court. At the same time he is trying to put his own disk on a high number.

When the three disks have been pushed by each player at one end of the court, that is called a *round*. At the end of each round the score is added. Then the two players at the other end play their round.

There are certain precautions to take to become a good player.

1. Avoid the "10 off" space. If a disk falls there, 10 points are subtracted from the total score at the end of each round.

2. Be careful to see that the head of the pusher or cue does not pass over the back line of the court.

3. Push the disk beyond the lines of each section. When the disks fall on a line, there is no score.

4. Use arm, trunk, and leg muscles with control and ease.

5. Play as well as you can, even if you are losing points.

6. Practice to improve your skill.

7. Stop when you are tired and rest.

8. Remember that proper food gives you vigor to play longer without becoming tired.

9. Play fairly.

Proper food and plenty of rest help your muscles become strong. They help you to grow taller and stronger. The tall boys and girls are good players because they can reach and stretch. Reaching and stretching are good for your back, shoulders, and arm muscles.

Things to Remember

1. Bacteria grow rapidly in soil and in water.
2. Decay means the breaking down of any complex substance into simple substances.
3. Harmful bacteria unless destroyed or controlled spoil foods that you would eat.
4. Controlling temperatures in which foods are kept is man's most useful method in controlling the growth of bacteria in food.
5. There are many ways in which to preserve or save food.
6. Salting, smoking, and drying are preserving methods which have been used for hundreds of years.
7. Canning, pasteurization, refrigeration, and quick freezing are effective ways to preserve foods.
8. Salting, drying, and smoking remove the moisture from food materials and thus kill or control the growth of bacteria.
9. Dried or dehydrated foods must have the water restored in them before they are used as foods.
10. Food is sterilized before it is put into sterilized cans to be kept safe.
11. The tanks on milk trucks are made on the same principle as the thermos or vacuum bottles.

12. Refrigeration is important to control the harmful bacteria in food.

Study Exercises and Questions

1. At what temperature do bacteria grow very slowly?
2. Make a list of the different ways harmful bacteria in foods are controlled or destroyed.
3. What were the earliest methods used in preserving food?
4. How does salting help to preserve foods?
5. How does the smoking of meat or fish prevent the growth of bacteria?
6. List at least six foods which are dried in order to preserve them.
7. What are the four major steps in the canning process?
8. What is done to milk in the pasteurization process?
9. What should be the temperature of the icebox or refrigerator?
10. List the different ways in which food is transported long distances by means of refrigeration.
11. What is the newest process of refrigerating foods?
12. At what temperature is food frozen?

Suggested Activities

1. Cut a hole about three fourths of the way through a potato or an apple. Then into the hole thus made,

put a teaspoonful of salt. Let the apple or potato stand for twenty-four hours. At the end of that time some very interesting facts should be revealed. Write a report of what has happened.

2. Visit a store that sells frozen foods. Make a list of foods sold and prepare to make a report to the class.

3. If it is possible to do so, visit a canning factory. Write a report of what you see and learn there.

4. Go to your grocery store and meat market sometime outside of rush hours, and ask the grocer or the butcher to show you the large refrigerator in the store. Note what is stored in the refrigerator. Note the temperature. Write a report for the class.

Words to Master

preserve	survive	dehydration
controlling	blanching	artificial
famine	antiseptic	sterilizing


SCIENTIST
DOCTOR
ULTRA VIOLET RAY
NATURE AND MAN FIGHT HARMFUL BACTERIA

CHAPTER IX

HARMFUL BACTERIA AND THE HUMAN BODY

How Bacteria Enter the Body

Through the Respiratory Tract. Harmful bacteria may enter the body in many different ways. These many ways can be put under one of three headings. One way the bacteria enter the body is through the respiratory tract. That is, the bacteria enter the openings in the nose. They may then pass on to the back part of the mouth. There the bacteria may be swallowed or pass on through the windpipe and enter the lungs.

Through the Digestive Tract. A second way in which bacteria enter the body is through the digestive tract. That is, they enter through the mouth and pass on into the digestive organs. Bacteria reach the mouth through the food you eat. Bacteria may also enter the mouth through the water you drink. Placing the fingers in the mouth is still another way.

Through Breaks in the Skin. A third way in which bacteria enter the body is through a break in the skin. The main function of the skin is to serve as a protective covering to the surface of the body. When a break occurs in the skin, bacteria may enter the body. The break in the skin may be caused by a scratch or a cut. A little later on you will learn more about how the skin protects you against harmful bacteria.

The War Against Bacteria

The Enemy Bacteria. The human body is one of the most complex things that lives. There are many parts to the human body. It is made up of arms, legs, hands, and feet. Then there are skin, bones, muscles, fat, and blood. There are many other parts of the human body. Each part is in itself a very complex structure which is composed of protein, fats, carbohydrates, water, and various mineral salts.

The business of bacteria is to change all complex animal matter into simpler substances. When bacteria get into your body, they could start to decay it, as they do meat, or eggs, or fish. They do this because they can do nothing else. That is what they are supposed to do. However, you do not speak of bacteria decaying people. You say that bacteria make people sick. When you are sick, the bacteria are trying to do to you what they do to meat, eggs, and other food. You do not want that to happen to you; therefore, you carry on a fight against bacteria.

As Fought by Science. Science has done much in this war against bacteria. Through a study of bacteria, science has discovered how to make safe the various things about you. Science has learned how to control or destroy harmful bacteria. Bacteria may be destroyed in two ways. The first way is by physical means. The second way is by chemical means.

The Physical Means. Bacteria may be destroyed by natural physical forces such as sunlight and drying. Sunlight kills many times more bacteria than any method used by man. Ultraviolet light has been discovered to be very good in this respect. Certain lamps can be purchased that will kill bacteria. You learned that all bacteria must have moisture in order to live and grow. Science has discovered that harmful bacteria will die after a few hours or even minutes of drying.

Harmful bacteria may also be destroyed by artificial physical means, that is, by ways discovered by man. Washing with soap and hot water is one way to kill bacteria. Many kinds of soap contain some disinfectant to help kill bacteria. It is important to keep things clean. Clean things are safe, and they are made clean by washing.

Bacteria are also destroyed by heat. You learned this when you studied about canning food. Dry heat, such as oven heat, boiling heat, and steam heat all destroy bacteria. Moist heat will destroy bacteria more effectively than dry heat. Sterilizing, you learned in Chapter Seven, is one of the best ways to kill bacteria. The use of live steam is still another way. Pasteurization is a means of destroying bacteria in milk.

The Chemical Means. Science has also discovered many chemical means to kill bacteria. Chemicals used in this way are called disinfectants. The use of disinfectants is known to all of you. Doctors and nurses use a disinfectant to sterilize the instruments they use. A disinfectant is used to sterilize a scratch, cut, or any open wound. Alcohol and many other chemicals may be used. Thus in many ways science is constantly carrying on a war against bacteria.

As Fought by Individuals. There are many ways you may fight against bacteria to protect yourselves. You are well aware of one of these ways. You know one part of the human body that bacteria decay is your teeth. Unfortunately, most people have decayed teeth at some time or other in their lives. So the problem is to find out how to fight against these bacteria. Knowing how the teeth are put together and how bacteria act on teeth will help you.

Study the various parts of the tooth. The enamel is a hard, dead layer that covers up the living layers underneath. You learned what bacteria do to dead things if conditions are right. Bacteria decay all dead things when the conditions are right. The enamel is a very hard substance and should be smooth and shiny. This makes it hard for bacteria to stay on it and cause decay. Sometimes the enamel is not smooth. There may even be a tiny hole in it. Then food material can get in that tiny hole. Bacteria get in there too. The bacteria decay the food material, forming acid, as in sour milk. The acid eats away the enamel, making the hole larger. More bacteria get in and the hole gets still larger. This process goes on and on. The enamel is thereby slowly destroyed.

Before it gets too large, the hole, or cavity, should be cleaned out by a dentist. The dentist then fills the cavity with a hard metal. This makes the surface of the tooth smooth and hard again. This helps to keep bacteria away and the bacteria cannot decay it any more. A tooth with a cavity that is not filled will finally decay to such an extent that it will have to be extracted. Your first and most important protection against the decay and loss of your teeth is to see a dentist. Clean teeth make you look well.

Your mouth also feels better when your teeth are clean. But only the dentist can stop decay.

Clean Bodies and Clean Clothes. Habits of cleanliness are important to kill bacteria. You learned that washing with soap and water will kill bacteria. When clothes are washed in soap and hot water, bacteria are destroyed. Keeping your bodies clean is also important. When you take a bath, you should use soap and water. When you wash your hands and face, use soap and water. These clean habits not only give you a neat appearance but help destroy bacteria.

You learned that you should avoid putting pencils and other objects in your mouth. Bacteria cling to the objects and may enter the body. Play safe at all times. Be sure to treat all scratches and cuts with some safe disinfectant. Make use of science in your war against bacteria.

Body Defenses against Bacteria

Three Defenses. You will now learn how bacteria affect you when they grow in you. There are certain things that you can do for yourself in the war against bacteria. In any war, defenses are needed. The body has three defenses against the destruction caused by bacteria.

The Skin as a Defense. The skin is the body's armor of protection against two powerful enemies. The skin covering the body is its first line of defense against the entrance of bacteria and dirt.

When you think of the skin as a body covering, you need to consider not just the parts you can see. The skin also covers the parts not easily seen. Some of these are the skin which lines the canal of the ear, the membrane or modified skin which covers the inside of the eyelids, the skin inside the mouth, or that which extends down the throat. Another

By Ewing Galloway, N. Y.

Enlarged model of skin structure showing layers, oil glands, and hair.

example is the skin lining of the nostrils. In order to give the body the best possible protection against bacteria, this body covering needs to be whole, or unbroken, and healthy.

A whole skin that is healthy is one with no breaks or cracks in it. Run your tongue all around your mouth. Notice that your mouth feels smooth, soft, and moist. Sometimes a person gets a break or crack in the skin of his mouth. This is true when you have a canker sore in your mouth. The canker sore hurts because the broken spot exposes the sensitive live skin underneath the lining. The skin covering of the hands, especially the fingers, is constantly being scratched and cut.

Boys and girls frequently have breaks in the skin which allow bacteria to enter the body. When that happens, there may be trouble. An example of this is a splinter in your hand or finger. When a splinter stays under the skin for even a few hours, that spot in the skin becomes red and sore. A short time later it may become infected; then the spot turns white. The body's first line of defense has been broken down and help is needed. This is where the body's second line of defense begins its work.

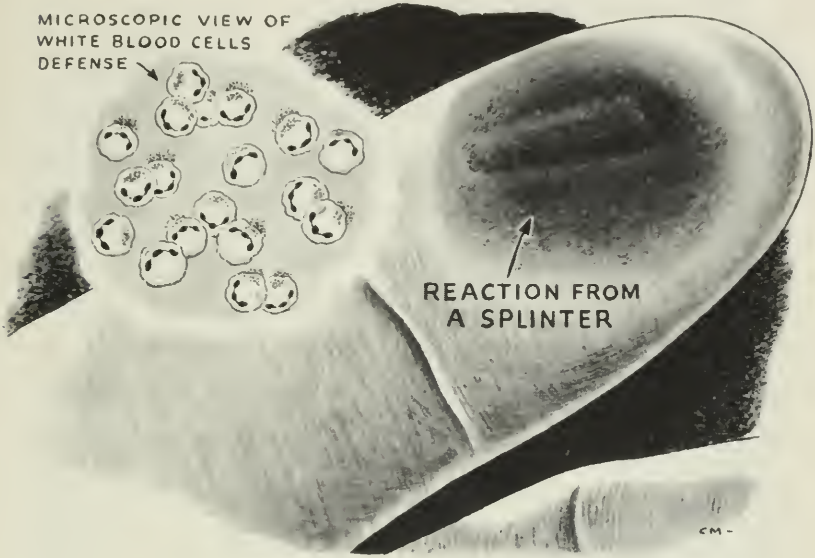
The Second Defense. You may have learned in your science classes that all living things are made of cells. The bones, muscles, tissues, and blood in the body are made of cells.

There are two kinds of cells which make up the blood, red cells and white cells. The white cells are called scavengers, the policemen of the body. The red cells, which are much more numerous, give the red color to the blood. They also carry oxygen to all parts of the body.

When something strange or foreign penetrates the skin, the work of the white cells begins. Now, think back to the splinter in the finger. A splinter is a foreign substance when it enters the body through the skin. Along with the splinter many bacteria may also enter the body. Immediately, the white cells go to work. They rush toward the bacteria, surround them, and actually begin to devour them.

All the activity and work of the white blood cells in trying to destroy the bacteria cause several things to happen.

Most of you know how a finger looks after a splinter has been in it for a few hours. The white



material which you see in the spot is the mass of white cells which are devouring bacteria. When there are enough white cells to destroy all the bacteria, as soon as the splinter is taken out, the red color of the skin will disappear, the soreness will go, and the skin will heal. When there are not enough white cells and the bacteria grow faster than the white cells can destroy them, then there will be need for help from outside the body. That means you probably will have to call upon a physician to help you.

Another example is a break in the enamel of a tooth. There are no fighting white blood cells in the enamel to destroy the harmful bacteria which are decaying it. There is no blood flowing through the enamel. Therefore, there is nothing to interfere with or to keep the bacteria from growing. The next step in the decay is for the bacteria to attack the dentin. Dentin is live tissue. There are white cells in the blood which flows through the dentin. But the amount of blood in the dentin is very small, so the white cells will not be much help. Not until the decay gets into the pulp will there be enough white cells to destroy the bacteria. By that time it is too late and the white cells, fight as they may, will not be strong enough to destroy all the bacteria that will be present. When this happens, you may have an abscess on the root of the tooth or at the gum. This causes an infected tooth, just as the splinter causes an infected finger. At this stage, the white cells need help. The dentist is the one to give help to the white cells. He must help you when you have an infected tooth in the same way that the doctor must help you when you have an infected finger.

Antitoxins

The Third Defense. In the process of breaking down the body, bacteria produce substances that are poisonous to you. The poison made by the bacteria gets into your blood and is carried all over the body. When this happens, the skin and white cells are no longer any help to you, because poison is a fluid and is inside the body. The skin can keep out bacteria, but it has no help against a liquid poison. White cells can eat whole bacteria but can do nothing against a liquid poison. Fortunately for you, the body is pretty well prepared for such an emergency. The body has on hand, or can make, something to combat the poisons produced by the bacteria.

An Example of a Liquid Poison. Ammonia is a poison to humans if they drink it, get it into their eyes, or on their skins. Sometime, by accident, you may get ammonia in your mouth. If that happens, something must be done. Something must be done to make the ammonia harmless, to destroy its poisonous effects.

Look at the picture on page 222 carefully, and you will see a small word, antidotes, under the word

poison. An antidote is something which combats or fights against a poison and so makes it harmless. A-n-t-i means against.

When you get ammonia in your mouth or on your hands, you have to apply an antidote to make it harmless.

Antidotes. Bacteria growing in your throat, nose, or teeth may produce poisons which spread through your blood. What you need to fight against poisons is an antidote, but not the kind of antidote you may find on the kitchen shelf.

Your body possesses the power of making antidotes for the poisons of most bacteria. Such antidotes help you get well when you are sick. Bacteria start to grow and produce poison. When the growth of bacteria begins in your body, your body begins to produce an antidote for the poison. For some days there is a struggle going on inside you. It is a struggle between the bacteria which produce poison and your body which produces an antidote for the poison. This is where the work of the body begins. This work is to produce more antidote than the bacteria can produce poison. The antidote in turn makes it impossible for the bacteria to live, so they die and you get well.

Thus you have three natural defenses against the invasion of harmful bacteria. The first natural defense is the unbroken skin. The second defense is the white cells of the blood. The third defense is the antidotes against certain bacterial poisons.

All through your discussion you have been using the words *poison* and *antidote.* Poisons produced by bacteria are called *toxins.* A toxin is a bacterial poison. The antidote for a bacterial poison or a toxin is called an *antitoxin.* Most of you may have heard the word *antitoxin* used.

The Family Physician. Since you have these three natural defenses against harmful bacteria, you may wonder why your family calls in a physician when you are ill. Sometimes you need help in your battle against bacteria.

The doctor can give you things that will help your body produce an antidote for the poison that is making you sick. Sometimes he may be able to bring you an antitoxin. This antitoxin has been secured from a person or an animal who had the same illness you have. This antitoxin will combat the poison that causes your illness.

How Antitoxins Fight Disease. An understanding of the way antitoxins fight bacterial poisons helps you to answer some very important questions.

It explains why all the members of a family do not catch mumps or whooping cough or scarlet fever when one of the family has the disease. One reason is that the family is careful to stay away from the sick person and not catch bacteria from him. Another reason is that some members of the family already had defenses for these diseases in their blood. That is the explanation in most cases.

Babies are usually vaccinated against smallpox, diphtheria, and whooping cough. If this is not done before the child is a year old, it should be done before he enters school. This produces defenses in the body which protect the child against these diseases.

Activity for Health

Bases on Ball. Bases on ball is a team game. It is a vigorous game and requires energy. The purpose of the game, as the name suggests, is to run around the bases, in order to make as high a score as possible. Good players must know how to kick, how to run, how to catch, and how to be good members of a team. All players on the team cooperate and play for fun and enjoyment.

It is played on a baseball diamond. Because you are not as grown up as the regular baseball players, the distance between bases is shorter. At first, the distance can measure twenty-five feet or more.

Instead of batting the ball to run as in baseball, the ball is kicked. Therefore, only balls that are made for kicking are used. A ball used for kicking has a thick outside cover. It is called a soccer ball. A ten-inch, heavy rubber ball may be used.

To play the game divide the players, boys and girls, into two equal teams. One team is placed on either side of the home plate. Each player on a team is given a number. Two players, a kicker and a fielder, play at a time. The two players take their turn in the right order, without losing time.

The players decide among themselves which of the two players numbered one is to kick first. Then, that player takes his place behind the home plate. The player numbered one on the opposite team takes his place out in the field.

The kicker places the ball on the home plate and kicks it out into the field. If it is a good kick, he runs around the diamond, touches each base in correct order, and tries to reach the home plate without being put out. The player in the field chases the ball, picks it up, and runs straight to home plate. He tries to reach there and to touch the plate with the ball before the kicker can reach home plate.

This game is different from baseball in these ways. Players on the two teams take turns in kicking and fielding. One point is scored for each base the kicker has touched before the fielder reaches home plate with the ball. For example, if the kicker touches two bases before the fielder reaches home plate, his score is two. If three bases are touched successfully, his score is three. Only one player stands in the field to receive the ball as it is kicked.

Bases on Ball is a good game for everyone. It allows everyone a turn to kick, run, and play in some position in the field. It offers everyone a chance to score.

Things to Remember

1. Bacteria may enter the body through the respiratory tract.
2. Bacteria may enter the body through the digestive tract.
3. Bacteria may enter the body through breaks in the skin.
4. The human body, one of the most complex living organisms, is made up of parts which are complex structures.

5. Science has learned how to control or destroy harmful bacteria.

6. Bacteria may be destroyed in two ways, by physical means, and by chemical means.

7. Sunlight kills many times more bacteria than any method used by man.

8. Ultraviolet ray light has been discovered to be very helpful in destroying bacteria.

9. Washing with soap and hot water is one way to kill bacteria.

10. Moist heat will kill bacteria.

11. Chemicals used to kill bacteria are called disinfectants.

12. Keeping your body clean helps to protect you from bacteria.

13. The red blood cells which give the red color to the blood carry oxygen to all parts of the body.

14. The white blood cells protect the body from bacteria.

15. The body can make and have on hand antidotes for poisons produced by bacteria.

16. Poisons made by bacteria are called toxins.

17. An antidote for a toxin is called an antitoxin.

Study Exercises and Questions

1. Where do sugars come from that bacteria use to form acid in the decay of teeth?

2. Why should we not use an excess of sweet foods in our diet?

3. Why is cleaning the teeth before going to bed a good practice?

4. List the three defenses the body has against the destruction caused by bacteria.

5. To whom do we turn for help when the three natural defenses are overcome?

6. Are infections confined to the skin of fingers and hands or teeth?

7. (a) What other parts of the body than hands and teeth may be infected? (b) What happens when a part of the body is infected?

8. What is the main function of the skin?

9. Name the three ways in which harmful bacteria may enter the body.

10. What natural physical forces destroy bacteria?

11. List three chemicals that are used to destroy bacteria.

Suggested Activities

1. Make a list of as many disinfectants as you can think of or find out about.

2. Make a list of as many physical means of fighting bacteria as you can find out about.

Words to Master

antidote	defenses	scavenger
digestive	antitoxins	toxins
disinfectant	respiratory	penetrate


DRINK PURE WATER
STATE INSPECTED SPRING
DRINK PURE MILK
PASTEURIZED MILK
CERTIFIED MILK
EAT PURE FOOD
A.K. Bilder
THREE WAYS OF AVOIDING HARMFUL BACTERIA

CHAPTER X

PREVENTING THE SPREAD OF DISEASE

How Disease Is Spread Through Harmful Bacteria

Bacteria That Cause Disease. In the previous chapter, you learned what happens when bacteria invade the human body. Most of the bacteria that make people sick usually live in the bodies of people. It is against these bacteria that you must protect yourself. If you know this fact, the methods of protecting yourself are fairly simple. What you need to know is how disease-producing bacteria can get from one person to another. Think of what you already know about bacteria.

A Vehicle for Travel. Bacteria have no method of locomotion or moving about. It is true that in a liquid there are a few kinds that can move very short distances. There is only one way that bacteria can get from one person to another. All bacteria are hitchhikers. They cannot go places themselves so they depend upon other things to carry them around. They cannot get from person to person unless they are carried.

Hunters and trappers living alone through the winter in the far north rarely have colds because they do not meet other people. People living close together or gathering in crowds may spread disease germs by sneezing, coughing, or spitting. Dirty hands may also carry germs from one to another.

Insects such as flies, fleas, lice, and mosquitoes may also carry germs. They may carry them by biting a sick person and then later biting a well person. Or these insects may carry bacteria on their bodies and feet after feeding on waste materials. This is especially true of flies.

Proper sanitary measures for the disposal of sewage and wastes are necessary, to prevent the spread of disease. Foods should be protected from flies and other insects to prevent bacteria from being carried to them. Later you will learn the importance of a pure water supply to protect you against the spread of disease.

An Entrance to the Body. A second fact about bacteria is important. Unless bacteria can find some way of getting into the body, a person cannot get a disease. But bacteria may enter the body in several ways. They may be swallowed, they may get in through the nose, or they may enter through a break in the skin, such as a cut or a scratch. Even after they get into the body, bacteria must be present in large numbers to cause disease. How great a number depends on the health of the person and the strength of the bacteria.

Growth of Bacteria in the Body. There is another important fact about bacteria and disease. After bacteria enter the body, they will not be harmful unless they are able to live and grow in the body. When bacteria enter the body, they must grow and reproduce themselves many times. Rarely do enough harmful bacteria get into the body to cause disease at once. Bacteria must have food to live and grow. The body is capable of destroying to some extent bacteria that enter the body. The body is capable of some resistance to the bacteria that enter.

Causing Injury to the Body. A final factor is necessary before harmful bacteria can cause disease. Bacteria must be able to cause injury to the body. There are several ways bacteria may produce injurious effects to the body. One way is to produce a poison. You learned about this in the previous chapter. Another way is to produce acid in the tissues of the body. Still another way is to produce gases in the tissues of the body. In fact, bacteria produce other substances in the body which science as yet does not understand and know much about. There are other ways not understood at the present time in which bacteria harm the body.

Thus, four things are necessary before bacteria can cause disease. First, bacteria must be carried by some sort of vehicle. Second, bacteria must find some way of entering the body. Third, bacteria must be able to live and grow in the body. Fourth, bacteria must be able to cause some injury to the body before they cause disease.

How Disease Is Spread by Human Beings

Through Dust and Dirt. Mothers are always careful to keep rugs and floors clean, especially if there is a baby in the house. As the baby crawls around on the floor, its hands pick up dirt. Babies usually put their fingers and hands in their mouths. In this way harmful bacteria may enter the body through the mouth and cause disease.

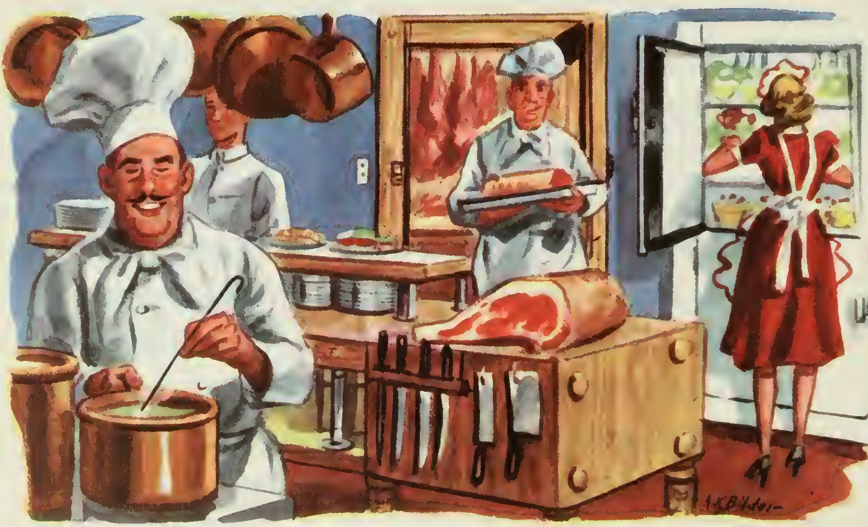
Sneezes and Coughs. When people sneeze, you usually do not see the tiny droplets that spray from their mouths because your eye is not fast enough. But every time you sneeze, a tremendous spray of saliva containing thousands of bacteria is shot from your mouth. This spray may extend three or four feet from you. The bacteria in each droplet do not immediately die. They may float around in the air to be breathed into the mouth or nose of some other person.

Bacteria grow well in the nose, mouth, and throat. Drops from these places which are sprayed into the air by sneezing and coughing will contain bacteria. When germs of some disease such as a cold are in the nose, mouth, or throat, the droplets will contain some of them. Therefore, when a person coughs or sneezes, he should cover up his mouth and nose with a handkerchief or cleansing tissue.

Handling Food. Another careless habit people have that helps bacteria to hitchhike from one person to another is improper care in handling food.

A restaurant chef and his kitchen helpers must handle the food when preparing it. It is important to wash the hands before handling food. This should be done to prevent the spread of disease bacteria from the sick to the well.

Food handlers should be clean. Food handlers should wash their hands frequently. As a matter of



fact, food handlers should not touch food itself. The hands touch many things which are handled by other people. It is easy for the hands to pick up bacteria.

Dangerous bacteria may be transferred from the hands to the food and then to the mouth. You can see the importance of washing your hands before handling food and before eating. That is why your mother has always wanted you to wash yourself before you eat or help to get food ready.

Utensils Used by Sick Persons. Another hitchhiking vehicle employed by bacteria is a dish or utensil used in eating. A sick person eating or drinking in a restaurant may spread disease to others. He may contaminate the dishes and utensils he uses. His sickness might be transmitted to the next person who uses those dishes. To prevent this, the dishes and utensils must be sterilized. This is done by washing the dishes and utensils in hot, soapy water and rinsing them in very hot water. This disinfects the dishes and utensils.

When a person is sick in your home, every precaution should be taken to prevent the spread of disease to others. When you are ill at home, the dishes you use should be kept separate from the dishes of the rest of the family.

Whenever possible, all things used by a sick person in the home should be boiled. Towels, linens, handkerchiefs, bed linen, dishes, and all utensils should be boiled. This is one of the best ways to prevent the spread of disease from one member of the family to another. Persons caring for the sick should take every precaution possible to prevent the spread of disease.

Putting Objects in Your Mouth. At school, you frequently use things such as pencils, penholders, scissors, and books in common with other children. These objects should not be put into the mouth. Putting things in the mouth might cause the spread of disease.

You have studied several routes used by bacteria in their hitchhike journey from one person to another. You learned that bacteria get into the body through breaks in the skin. They also get into the body through openings, such as the mouth, eyes, and nose.

Protection against Bacteria in Body Openings. You have some natural protections against bacteria entering through the mouth, eyes, and nose. These protections are unbroken skin, white cells, and antitoxins.

The constant bath of moisture from tear glands in the eyes is slightly antiseptic. It drains into the back of the nose, is swallowed, and the bacteria are destroyed in the acids of the stomach.

Fine hairs in the nose stop most of the dust and the bacterial hitchhikers. Sticky secretions of the nose catch and wash away bacteria into the back of the throat. Then they are either swallowed or discharged in spit.

In the mouth saliva is slightly antiseptic. It washes away many bacteria which are swallowed and destroyed, or are expectorated.

How Disease Is Spread by Water

Importance of Water. Water is very important in people's lives. You know that without water you could not live. Your body is more than half water. In order to keep it working right, a fresh supply of water is needed every day. No one can live more than a few days without water. You must have not just water, but good water. You remember that bacteria are found in water. Sometimes bacteria found in water can be disease-producing. Therefore, good pure water is water with no disease-producing bacteria in it.

Source of Water. The original source of all water is rainfall. The falling rain is pure and clean and there are no bacteria in rain. Bacteria get into the water from the soil. Most bacteria found in the soil are harmless and water flowing over such soil should have no disease-producing bacteria in it.

Now this was true of the creeks, brooks, ponds, and lakes in the early history of our country, before there were so many people living close together in towns and cities. Wherever people begin to settle they soon contaminate the pure water with waste from their bodies and houses.

If you had lived in New York City more than a hundred years ago, you would have gone to a pump in the middle of the town to get water for your tea. It was called the Chatham Street Tea Water Pump. In those days there was no running water in houses. When people wanted water for drinking, cooking, or washing, they had to go to the pump in the center of the town square.

One day when the people went to the pump for water, the handle was gone. What excitement there was. Where were they to get water? But the townspeople were not permitted to take water from the well. The water in the well was no longer safe to drink. There had been many people sick in the town and all with the same illness.

The doctors had tried to find the cause of this illness, and only one thing seemed to make sense. Every person who was sick had taken water from the Chatham Street well. Those who obtained their water from any other source were not sick. Therefore, doctors said if they closed up the well, no more people would become sick. They closed the well and people stopped being sick.

The people had not been careful of the waste water from their homes and their outside toilets. These waste waters, sometimes thrown right out in the back yards, were seeping down through the ground until they met the clean water that flowed into the well. The dirty water and the clean water mixed together and flowed into the well from which the people drank. The well water was contaminated.

Some methods for the safe disposal of waste water had to be provided. In this case, a system of pipes was laid from house to house. The waste water was collected and carried away from the source of drinking water to a place where it could do no harm. When that had been done, the Chatham Street Pump could be used again.

The water from wells should not be used unless it has been inspected and tested by the district, county, or state health department. Many states test samples of water from wells.

Typhoid Fever Carried by Water. Typhoid fever is the disease most commonly carried by water. Proper disposal of body wastes is important to prevent this disease.

When on a camping trip you can find no health department sign to help you to decide whether water is safe or not, there is one sure method of purification which you can use. Boiling water rapidly for 20 to 30 minutes will make it safe to drink.

City Water Supplies. People who live in large cities seldom have to worry about good, safe water because it is the responsibility of the city government to supply such water. But occasionally something happens.

Floods may destroy the safety of drinking water in some of the cities along the flooded rivers. At such times the muddy flood waters sweep over all the lands, carrying all sorts of contamination with them. This infected water may get into the wells and reservoirs of the city water supplies and make the water unfit to drink. Then something must be done. People must boil the water to make it safe.

The Common Drinking Cup. Another way that water may spread disease is by use of a common drinking cup. That means, one cup used by everyone. It is an excellent way for bacteria to hitchhike from one person to another. You seldom see any drinking cups in public places nowadays.

Drinking fountains are used in railroad stations, theaters, schools, rest rooms, gas stations, and other public places where people can get a drink of water. The individual paper cup or the drinking fountain is better than the common drinking cup. It prevents bacteria from hitchhiking from one person to another.

How Disease Is Spread by Milk

Early Milk Supply. A great deal of work and expense go into keeping milk pure and safe. The stories of pure water and pure milk are almost the same. When people lived in smaller groups, usually each family had its own cow. It was also convenient to buy milk from a neighbor. It was easy to tell whether the neighbor was a careful farmer and kept the milk clean by the way he kept his barn and his cow. When numbers of people living in groups grew larger, it was not so simple a matter to be sure the milk came from a clean farm.

The persons buying the milk cannot know much about the milk supply. Therefore, the people at the head of communities or cities take charge of the milk supply in order to make it safe.

Making Milk Safe. A number of things are done to insure a safe milk supply. Cows not only have diseases themselves, but they can spread these diseases to people. This is done by passing along disease-producing bacteria in the milk. You may have heard of a disease which may be transmitted from cows to humans. Tuberculosis is one disease which can be carried in milk. Therefore, people looking after the milk supply of a community need to be sure that milk comes from healthy cows.

The second thing of importance in producing pure milk is a clean barn where the cows are kept. Such things as cement floors, clean walls, and windows giving plenty of light and air tell you that a barn is clean. Cows sometimes have individual drinking vessels. The milkers are required to keep themselves clean and healthy. They wash their hands thoroughly with soap and water immedi-

ately before beginning their work. Big dairies require the milkers to be examined regularly by a doctor. This is done to make sure they do not have a disease.

Milk is very easily infected with disease germs. If a milker should have any sort of communicable disease, a slight sore throat, or the beginning of typhoid fever, for example, the bacteria causing that disease could easily get into the milk from the milker's hands. Such bacteria would grow in the milk, thus spreading the disease to a person who drinks the milk.

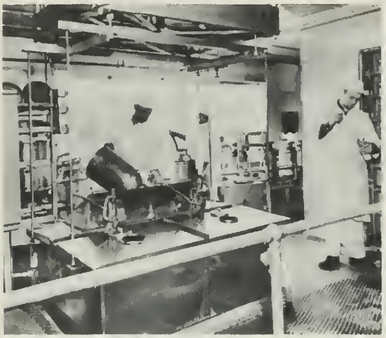
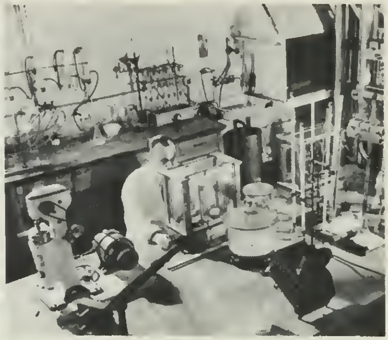
Steps in Caring for Milk. Milk as it comes from the cow is warm. Therefore, the next step in caring for the milk is cooling it. That must be done immediately. Milk must be cooled quickly in order to slow up the growth of bacteria. You recall that bacteria do not grow very fast in temperatures between 40° and 50°.

The warm milk is poured into cans, taken to the milk house, and kept at a temperature between 40° and 50° for a few hours until it is picked up and taken to a country milk station. From this station the milk is shipped, either in milk trucks or trains, to the dairies.

Milk trucks and the cars of a milk train are lined with glass. They are really just big thermos or vacuum bottles, made like the ones many of your fathers carry with their lunches, or like the one you take to a picnic in the summer.

The milk in the trucks and trains stays at the same temperature until it arrives at the dairy. The milk shippers are very careful to keep the milk at icebox temperature to be sure that bacteria do not get a chance to grow.

The milk arrives at the dairy within a few hours. Every moment of that time, it is carefully watched to keep it clean, and to see that no new bacteria

By Ewing Galloway, N. Y.

The temperature is taken of milk as it enters the dairy.

Many tests are made in this large dairy laboratory.

get into it. In order to be absolutely certain that harmful bacteria have no chance to grow, the last step in the process is taken at the dairy. This process at the dairy which kills all the harmful bacteria is pasteurization. Pasteurizing milk, you recall, means keeping it at a temperature of 145° F. for one-half hour. When pasteurization is completed, the milk is absolutely safe for everyone to drink.

Bottling and Delivering the Milk. The next step is the bottling of the milk. Machinery does all the work and no hands touch the bottles until after the capping. Then the bottles are placed in boxes and loaded on milk wagons or trucks for daily delivery to your doorstep.

It was mentioned that tuberculosis is one disease which can be carried by milk. Other diseases which may be spread through the use of raw milk are diphtheria, septic sore throat, scarlet fever, and malta fever. Play safe by using pasteurized milk.

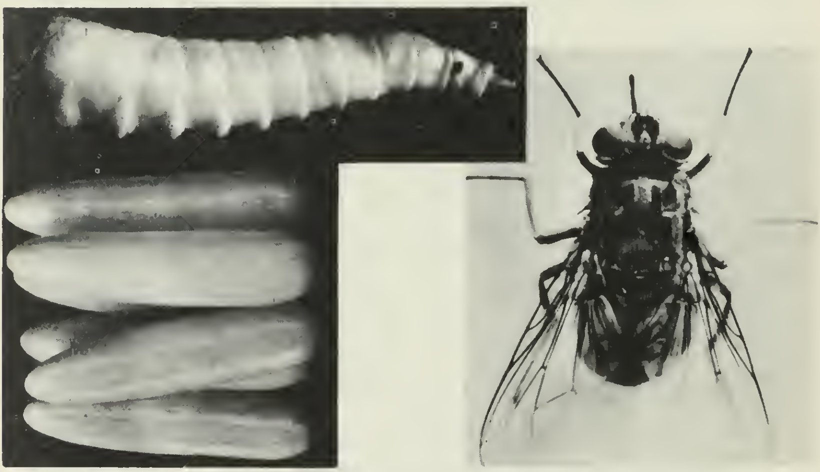
How Disease Is Spread by Insects

Insects That Spread Disease. Disease is also spread by insects. Such insects as bedbugs, fleas, flies, lice, mosquitoes, and roaches spread disease to human beings. These insects cause man much trouble and expense. You will study about the two most common insects that spread disease, the fly and the mosquito.

How Flies Spread Disease. Disease is spread by flies in one of several ways. Some flies are known as biting flies. These are the horsefly and the deer fly. The bite of these flies pierces the skin. That makes an opening for the disease-producing bacteria, which the fly may be carrying, to enter the body. In this manner, some diseases may be passed from one person to another.

There are many kinds of non-biting flies. They can, however, spread disease. The common housefly is one of them. They spread disease by mechanical means. The housefly's body is covered with fine hairs and bristles and so filth of all kinds is picked up as it walks about. The fly's legs may carry disease-producing bacteria. The fly may also carry disease-producing bacteria in its mouth and body. Thus, body wastes and vomiting by the fly may spread disease.

Destroying the Fly. To control the spread of disease by flies you must know how to destroy them. A study of how insects grow and develop will give you some idea of how to destroy them.



By Ewing Galloway, N. Y.

The eggs and larvae of the housefly and a full-grown fly.

The fly has four stages in his life cycle just as other insects have. The female fly lays from one hundred fifty to two hundred eggs at one time. The eggs hatch into tiny, white worms called maggots, in a few hours. The maggots are the larva stage of the fly's development and grow very rapidly, feeding on the dirt and filth where they have hatched.

In four or five days the larva takes on a thick brownish shell and this is the pupa stage of its life cycle. In another few days, a full-grown fly breaks out of the pupa and begins its deadly work.

How short a time it takes for these hundred or more eggs to become full-grown insects! It has been calculated that the number of flies produced by one female fly which began laying eggs in the spring may be nearly six trillion by the time you are returning to school in September. You can see why people should begin early in spring to kill every fly they see.

To eliminate the flies you must eliminate their breeding places. The fly usually selects a garbage can, a manure pile, or some other place where there is filth and refuse in which to lay her eggs. Garbage cans should be kept covered. Weekly collection of garbage is important. This removes the garbage before larvae develop into full-grown flies. Garbage cans should be cleaned and scrubbed regularly with strong soap and water.

Science has discovered many chemicals which will destroy insects. One of these is D. D. T. Garbage cans may be sprayed with D. D. T. This kills all flies.

The most common breeding place for flies is in manure. When the flies are larvae, they burrow into the loose ground just beneath the manure piles. Knowing this, people can do something to get rid of these larvae.

Manure piles should be cleared at least every week to prevent the growth of flies. If this is impossible, then storage places should be built with solid floors and be kept tightly covered. The floors can be treated with chemicals to destroy the larvae.

The Mosquito. The mosquito, too, is a flying insect that may spread disease. The mosquito is born and spends part of its life in the water. However, like the fly, it passes through four stages of development. These are the egg, the larva, the pupa, and the adult winged insect. Like the fly, the mosquito lays many millions of eggs in a few months. She lays her eggs in quiet, stagnant water. That kind of water is usually dirty and full of filth.

Here, again, is an insect using an unhealthful spot in which to lay its eggs. From these eggs, in a day or two, come wigglers. These are very tiny, thread-like animals which need to come to the surface of the water in order to breathe. The next stage, the pupa, comes in about a week and then after a few days the full-grown mosquito emerges and flies away to begin its work of being a pest.

Destroying the Mosquito. There are many ways of destroying this pest. The place to start to do this is stagnant water. Be sure there are no places around your house and yard where water may collect and become stagnant.

Discarded tin cans or pans, and bottles with water standing in them make excellent places for the mosquito to lay her eggs. Cisterns, water barrels, wells, tubs, and all containers used for the storage of water should be covered tightly. These are all breeding places for mosquitoes.

Stagnant water may also be found in pools, in ditches, in sewers, in marshes and swamps, and many other places. Draining swamps, cleaning out sewer traps, and other efforts toward eliminating stagnant water all help to eliminate such breeding places.

Even where stagnant water cannot be eliminated, you can prevent the mosquito from developing into a winged insect. Mosquitoes can be destroyed in the larva or wiggler stage. In many communities the pools of water in which the wigglers are growing are sprayed with a thin coating of oil. The oil on the surface of the water prevents the wigglers from breathing. When they cannot breathe, they die.

How the Mosquito Spreads Bacteria. It is the bite of the mosquito which causes discomfort and may cause disease. When a mosquito bites a person, a few drops of blood are sucked into its body. If these few drops of blood have disease-producing bacteria in them, the next person the mosquito bites will receive some of these bacteria into his blood. A mosquito must bite a sick person and then a well person to spread the disease-producing bacteria.

Fortunately for man, not all mosquitoes carry disease. But any mosquito bite may become infected. Therefore, to destroy the mosquito before it has a chance to bite is a good rule. Science has discovered certain chemicals, one of which you read about in this chapter, that will kill mosquitoes and all insects.

Activities for Health

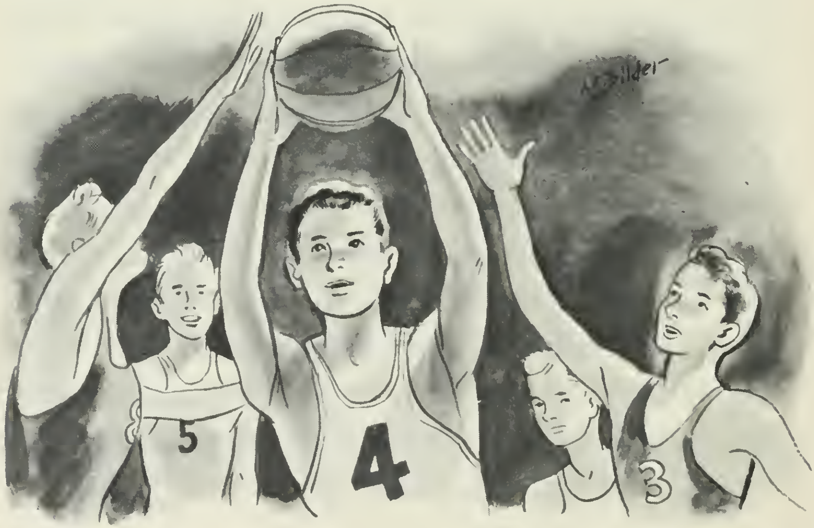
Basketball. Basketball is a popular game usually played during the winter season by teams representing schools and colleges. In basketball you practice the skills of shooting baskets, passing, and dribbling the ball. Dribbling means bouncing the ball while running. You are getting ready to play basketball by playing easier games related to the real game. While you are growing stronger and older, you can learn to understand the many points of the game when you watch a game.

Here are some points for you to think about. After a goal is made, the ball is thrown back into play by the team that did not make the basket. That is fair, because it gives the opposing team the courtesy of having the ball after two points have been won by the team that made the goal.

You hear players talking about long shots and short shots. A shot in a basketball game is a throw for the basket. Long shots are not considered good game strategy. Most basketball games are won by the team that has the best chance to play close to the baskets or goals.

Traveling with the ball means running more than two steps with the ball in the player's hands. Running with the ball is not permitted in basketball.

When you watch games of any kind, you are a spectator. A spectator has responsibilities in a game



just as a player on a team has. Spectators do not applaud when a foul is called on any team. They do not "boo" anyone, either the referee or the players. You remember that players on both teams and the officials, the referee and the umpire, are doing the best they can. The good playing is what counts and you cheer when the players are playing well.

It takes strength and endurance to play the strenuous game of basketball. It requires a healthy heart, strong muscles for running, steady hands, and a clear eye for good shooting.

A variety of good food, enough rest every day, and a will to practice the skills of basketball regularly will prepare you to become a basketball player rather than a spectator.

Place a hoop or a bushel basket on a tree in the backyard and practice shooting baskets at home.

Bowling. When you are older, you will want to be a member of a bowling team. If you take part in any sport, you learn how to have fun with other people. To become a good citizen, it is just as necessary for a boy or a girl to have fun in life as it is to eat and sleep. You are growing up now but very soon you may have a favorite sport. You can practice bowling a ball now while you are young and learn first lessons about body balance. Body balance is important in any game and very important if you want to become a good bowler. Hands, arms, and feet work together. If they work well together, body balance is acquired.

First of all, in bowling you must learn to bend your shoulders and to squat or crouch at the starting position. In the starting position in bowling a player stands ready to bowl the ball forward to knock down ten pins. You may not have the regular bowling ball and the ten pins, but you can practice the skill of bowling with a baseball and you can learn to roll a ball in a straight line between two chalk lines about the width of a bowling alley. At home you can practice rolling the ball to a playmate on the sidewalk or the driveway.

Remember these points.

1. Hold the ball a little above the waist line.

2. Take three or four steps forward and push the ball away from you. Pushing the ball is called the delivery. The ball must touch the floor as soon as it leaves the hand. The push after the run will direct the ball in a straight line.

3. The left foot is pointed straight ahead. So is the head. Eyes should look straight ahead. The running steps must be in a straight line. This will give the ball the straight line direction after the delivery. That is an example of control—body control and, therefore, ball control.

Things to Remember

1. Most of the bacteria that make people sick usually live in the bodies of people.
2. Bacteria cannot get from person to person unless they are carried.
3. Some diseases are spread through discharges from the intestinal tract.
4. Another group of diseases is spread by discharges from the nose and mouth.
5. A third group of diseases is spread by the bites of insects.
6. Bacteria must get into the body and live and grow there in order to cause disease there.
7. Bacteria must be able to cause some injury to the body before they cause disease.
8. Every uncovered sneeze sprays thousands of bacteria into the air around you.
9. Unclean handling of food can spread disease.
10. Using dishes or utensils after a sick person without sterlizing them first spreads disease.

11. Putting things in your mouth is a way of letting harmful bacteria into your body.

12. In order to keep the body working right, a fresh supply of pure water is needed every day.

13. Proper disposal of body wastes is important to prevent disease.

14. Sharing a common drinking cup is one way of spreading disease.

15. Milk is pasteurized to make certain that harmful bacteria have no chance to grow in it.

16. Flies and mosquitoes must be destroyed to prevent the spread of disease.

Study Exercises and Questions

1. List three ways in which bacteria hitchhike from one person to another.

2. List the different ways in which bacteria may get into the body.

3. What four things are necessary before bacteria can cause disease?

4. When a person is sick in your home, what precautions should be taken to prevent the spread of disease to other members of the household?

5. What must be done to dispose of waste water from houses?

6. How does your city or community insure a safe water supply for its people?

7. How can floods contaminate the water supply of a city?

8. If on a camping trip you are not sure a water supply is safe to drink, what should be done?
9. List the six steps necessary in safeguarding milk.
10. How many breeding places can you name for the fly? For the mosquito?
11. What four stages of development does the fly go through? The mosquito?
12. How may mosquito wigglers be destroyed?

Suggested Activities

1. Be prepared to tell how communicable diseases may be spread in eating places, schools, theatres, and churches. Tell what precautions people should take in each case.
2. Find out what is done to make swimming pools safe to use.
3. If a microscope is available, examine the leg of a fly. Note how he is equipped to carry and spread disease.
4. Find out what D.D.T. really means. Write an explanation.
5. If possible, plan a trip to your local water works, a sewage disposal plant, or a dairy farm. Write a report of your trip.

Words to Master

contaminate	sewage	sanitation
injurious	precaution	larvae
locomotion	secretions	pupa

KEEPING FIT HELPS PROTECT YOUR HEALTH

CHAPTER XI

PROTECTING YOUR HEALTH

The Importance of Keeping Fit

Physical Fitness of the Armed Forces. Keeping fit is an expression you may have heard many times. In fact, it is an expression you hear often. During the last World War it was important for the fighting men to be fit. The armed forces had to have men who had strength, stamina, endurance, and power. The men in service had to have strong healthy bodies. They had to be brave and strong in order to win the war.

Your government planned many activities to develop such qualities in its fighting men. Everything possible was done to make them healthy. Soldiers, sailors, marines, pilots, gunners, Waves, Wacs, —everyone in every branch of service had to be fit for service in the armed forces.

Men and women serving their country in the armed forces receive many health services. These services are provided by doctors, dentists, nurses, and others whose job it is to keep the armed forces healthy and strong. Special attention is given to sanitation. Those in the armed forces eat plenty of good, wholesome food. They get the proper amount of rest and sleep. They are given opportunity for playing games, sports, and other activities. All these things and many others keep the fighting forces fit.

Health Fitness for Civilians. It is just as important for all civilians to keep fit. Keeping fit means taking care of your body to keep it in good condition. It is important to keep your body in good condition for work. It helps you perform your tasks more easily. You are able to mow the grass, shovel snow, and do other chores without getting too tired. Your work at school or at home is easier if you feel well.

It is also important to keep your body in good condition for play. It is fun to be always ready for a game of ball or a hike in the country. Playing games is not only fun; it helps you to be fit so you can carry on your daily tasks. That is why you have been playing the many games and relays in your school. It's fun to be fit.

How to Keep Fit

Following Health Rules. You can help to keep yourself fit by following some simple health rules. These are rules with which you are familiar because you have discussed them many times. Cleanliness, food, rest, and activity are important for keeping fit. Some of these things will be new to you. Others will be a review of what has been mentioned before. Following these important health rules will help you to keep fit.

Cleanliness and Fitness. You have learned how disease-producing bacteria spread and cause disease. You learned that soap and water help to destroy such bacteria. Cleanliness is important in this respect. Cleanliness may mean taking a bath every day. Girls and boys who are very active may find a bath a day necessary. In summer, most people perspire freely. The perspiration contains much waste material. Perspiration is one way by which waste material is removed from within the body. Frequent bathing will wash away perspiration. When perspiration is not washed away daily, it dries on the skin and leaves an unpleasant odor. Thus, you can see the importance of a daily bath.

You also learned that the fingers and hands collect bacteria on them. The hands should be washed especially before and after eating. They should also be washed after going to the toilet.

Elimination of waste material through body openings is another way to keep the body clean. A bowel movement every day is important in keeping the body healthy. Plenty of vegetables in the diet is helpful in this respect. Vegetables provide roughage in the diet. This not only helps you digest your food but helps in bowel elimination.

Cleanliness applies also to the care of the teeth. Teeth should be brushed at least twice every day. They should be brushed the first thing in the morning and when you are getting ready for bed at night. Wise people brush their teeth after every meal, too. You learned that teeth that are not taken care of may cause much trouble. So take good care of your teeth.

Proper Food and Fitness. Proper food is important in keeping the body in good condition. You have discussed the basic seven food groups as a guide for proper eating. The foods in each of these groups are needed by the body. No groups should

be omitted from the daily diet. They all help to make and keep your body fit.

Rest and Good Health. Sleep and rest are important, too. All day long you are busy, active girls and boys. Your body needs time to rest and repair its muscles and tissues. Nine hours of sleep and rest will help to keep your body in good condition.

Activity, both indoors and outdoors, is necessary for a healthy body. Your school day has periods of activity. There are many different activities for you at home. The body needs about two hours of outdoor activity daily. Of course, the amount and kind of activity may depend upon the weather. Activity increases the strength and endurance of your body. Endurance is important when you are growing rapidly.

Some Things to Avoid

Saboteurs. There are many things girls and boys can do to keep themselves healthy. There are other things that girls and boys should avoid doing. Tea, coffee, alcohol, and tobacco, which contain harmful drugs, are some things to be avoided. These things are sometimes called saboteurs. You probably have read or heard about people who destroy property or buildings to aid an enemy. Such people are called saboteurs. They are found guilty of sabotage. Tea, coffee, tobacco, and alcohol are harmful to the healthy body you are trying to build.

Tea and Coffee. Tea and coffee contain no materials to help you grow or to keep fit. They do contain drugs which may do you harm. The drug found in coffee is called caffeine. Caffeine excites or stimulates the nerves and often interferes with proper rest and sleep. Tea and coffee have no food value. There are so many good drinks from which to choose that it seems a waste of time to drink tea and coffee. If you drink tea and coffee, you may crowd milk and fruit juices out of your diet. Tea and coffee are drinks to be avoided while you are growing. Eat and drink instead the foods that help you to grow properly.

Tobacco. Doctors, nurses, and others who are interested in children advise them against the use of tobacco. They know it is harmful to growing girls and boys. Tobacco contains several poisons. Nicotine is one of these poisons. Nicotine is often used as a spray to kill harmful insects in the garden. The poisons in tobacco irritate the delicate linings of the nose and throat. That is why many people cough when there is tobacco smoke in a room.

Nicotine causes the heart to beat faster and the breath to become shorter. The effect reduces a person's endurance in games and stunts. Athletic coaches have very strict rules against players' smoking. They know the results of smoking will show in games which require endurance and strength. Tobacco is a hindrance to growing girls and boys.

Alcohol. Alcohol is another liquid which is not needed by the body. It does not help in growth or development of any part of the body. There is no nourishment in alcohol. There is no muscle-building food in it. In fact, alcohol reduces the strength and endurance of the muscles.

Alcohol looks like water but it acts quite differently. Outside the body, alcohol has many different uses. It is helpful in rubbing sore or stiff muscles. It is useful as a disinfectant in killing the germs in a scratch or cut. Mixed with water it makes a good anti-freeze for the radiator of a car. It is useful as an anti-freeze because it will not freeze even in the coldest weather the world has ever known. Because it mixes with water, it is used to remove water from many substances. This process is called dehydrating. It kills germs by removing the water from them.

Harmful Effects of Alcohol. Inside the body, alcohol is harmful. It is taken into the blood stream very quickly and travels to all parts of the body. Here, too, it takes water away from the tissues and cells. This interferes with the work of the muscles and nerves. Another action of alcohol is dissolving fatty substances and oils. Certain fatty substances are important in brain cells and other cells. This action of alcohol is harmful to brain cells.

When the brain cells are interfered with, man's actions and speech are affected. He may lose control over them. He may talk and laugh noisily and do foolish things because his good judgment and common sense are affected.

Alcohol often makes a person unreliable. He is unable to think or to act quickly. Pilots, bus drivers, and engineers who are responsible for the safety of others are not allowed to take alcoholic drinks. Owners of stores and factories like to hire men who do not use alcohol. Many employers have found that users of alcohol tire easily. They do less work and are more likely to cause accidents.

Alcohol breaks down a person's resistance to disease because it interferes with the work of the cells and tissues of the body. Constant users of alcohol do not recover quickly or easily from serious illness. These people may lose many hours of work during the year. They also lose much money in wages. They may even lose the opportunity to be promoted in their work.

Government Control and Alcohol. Governments have known for a long time the danger of alcohol to growing girls and boys. There are laws controlling its manufacture and sale. A person who drinks unwisely affects not only himself but the whole community. Safety and good work require careful thinking and acting. Alcohol keeps a person from thinking quickly and wisely. It may cause him to make mistakes. It may keep him from doing his best work. A good citizen tries to have and keep good health. A good citizen avoids habits which may harm him and others.

Other Harmful Drugs. In discussing tea and coffee, caffeine was mentioned as a drug. A drug is defined as a substance used as a medicine or in making a medicine. Another word for drug is narcotic. Many drugs, or narcotics, are used to relieve pain. When a person is very ill, a doctor may prescribe a narcotic to ease his suffering and to help him sleep. Dentists sometimes use a drug when they need to ease the pain in your tooth. Drugs are able to ease the pain because they affect the nervous system. They should be used only when prescribed by a physician. Drugs are very dangerous for a person to take except by order of a doctor.

Opium and Marijuana. Opium is a very harmful drug. It is made from the seeds of the poppy plant. You probably read about opium when you studied about China in your geography. There is a similar drug called marijuana. This, too, is made from a plant. Someone has said to use marijuana is more dangerous than to experiment with a rattlesnake! Many drugs are harmful because people form the habit of using them. A person who forms the habit thinks he cannot live without them. Drugs do the body no good. They are harmful because they take away the appetite for the proper foods. They affect the nervous centers in the brain which control thinking and acting. When a person loses control of his thinking and acting, he may do things which are very wrong.

Government Control of Sale of Drugs. The government tries to control the manufacture and sale of drugs, but control by law is very difficult. When used wisely, drugs can be useful to men. In ancient times, people observed the effects of these drugs but could not explain them. Today, modern experiments show how drugs affect the body. Man has knowledge of the effects of such drugs on his body. This knowledge should warn him of the danger. The responsibility for using these drugs rests upon each individual person. He can know in advance what will happen if he wants the facts. When a person needs energy for extra work, he can provide for it by having proper food and rest. Drugs are harmful to growing girls and boys. They are no help in keeping fit.

Activity for Health

Snatch the Club, Beanbag, or Handkerchief. This is an exciting game. It requires very little space and no expensive materials. Small or large groups may play it. Large or small, the total number of players is divided into two equal groups. Each player in the group is given a number. For example, if there are ten persons in each group, they will be numbered from one to ten.

To play the game, each group forms a line. The players face each other in two lines. These lines are the goals. The players are arranged so that number one of the first group will stand across from number ten of the other group. The space between the two goals is about fifteen feet wide. An object is placed in the center of this fifteen-foot space. The object is placed so that it can be snatched easily.

The leader starts the contest. He or she stands at one side near enough to be heard. He calls a num-

ber. If he calls number seven, the two players whose number is seven run out from the line and try to snatch the object. The player who gets the object tries to run back home to his proper place in the line without being tagged by the player who has failed to snatch the object. If the player reaches his place without being tagged, he wins a point.

There is much enjoyment and fun in this game. A great amount of strategy may be used. Strategy is another word for planning to gain a point. Good players will pretend to snatch the object. They will keep the other players guessing. Then they will snatch the object quickly and take off for home. Home in this game is the goal. A goal is a place where players are safe from being tagged.

The distance between the two lines may be increased to allow more distance to run. This will make the game more difficult and more vigorous.

It is the leader's job to start each part of the game without loss of time. He also calls numbers quickly and clearly. He calls all numbers. Then, everyone has a chance to play in a short time. It is fair to give up when one is tagged. Everyone needs to watch closely in this game.

Things to Remember

1. Men and women serving their country in the armed forces receive many health services.
2. Keeping fit means taking care of your body to keep it in good condition.
3. Cleanliness, food, rest, and activity are important for keeping fit.
4. Perspiration is one way by which waste material is removed from within the body.
5. Elimination of waste material through body openings is one way to keep the body clean.
6. Keeping the hands clean is one way to prevent bacteria from entering the body.
7. Proper food is important in keeping the body in good condition.
8. Sleep and rest are important in keeping the body fit.
9. Activity, both indoors and outdoors, increases the strength and endurance of your body.

10. Tea, coffee, alcohol, tobacco, and harmful drugs are to be avoided.

Study Exercises and Questions

1. List at least five things important to keeping fit.
2. What are three things that characterize the men in the armed forces?
3. Why is it important for you to keep well?
4. What does proper food do for the body?
5. Why are rest and sleep important?
6. What does activity do for you?
7. What drug is found in both tea and coffee?
8. What particular poison is found in tobacco?
9. What are some of the harmful effects of smoking?
10. What harmful effects does the use of alcohol have on the body?

Suggested Activities

1. Make a chart of the health rules that help to keep you fit. Check each rule as you carry it out for one week. Study your chart to see whether you are doing everything you can to keep your body in good health.
2. Make an original poster, using pictures cut from magazines, to illustrate one bad effect of alcohol or narcotics.

Words to Master

endurance	alcoholic	nicotine
caffeine	stamina	narcotic

A GOOD HOME ENVIRONMENT CONTRIBUTES TO GOOD HEALTH

CHAPTER XII

YOUR HEALTH

Health in the Home

Your Health Rules. You will now learn about some of the things that are done for children to protect their health and safety. You have learned the importance of cleanliness, proper food, rest, and activity. You learned how important it is to have good health habits.

Good health habits mean the actual doing of the things you say should be done. They mean putting into practice good health rules. These rules apply to such things as washing your hands and face, brushing your teeth, combing your hair, eating good, wholesome food, getting plenty of rest and sleep, plenty of outdoor play, and many other healthful activities. All these things and many more you do for yourself. It is your responsibility to do them every day. Practicing health rules helps you live a happy, healthy life.

Health at Home. Many things that are important to protect your health and safety are done by other people. Your parents build a healthy home environment for you. Cleanliness, adequate food, comfortable rest, and happiness are valuable parts of a home. Your parents with help from you try to maintain and improve this environment for your growth and development into healthy and happy adults.

Health in the Community

Doctors and Hospitals. You like to feel proud of your community or neighborhood. In your community there are certain people interested in your

health. The doctor is a real friend when you need him. He is interested in keeping you well and helps you if you become ill. The dentist is necessary to keep your teeth clean and sound. The hospital is ready to serve you when it is needed. The health department of the city or county with the public health doctors, nurses, sanitary engineers, and other trained people protects the health of the community. Their duty is to see that you live in a wholesome environment.

The schools are an important part of every community. Because of the importance of healthy growing children the physicians, nurses, and dentists frequently go to the schools to see the children. Good health is necessary to help boys and girls to do good work in school.

The Health Examination. You have had examinations or tests in arithmetic and English. Most likely you have had a health examination given by the doctor and an examination of your teeth by the dentist. The health examination is sometimes called a physical examination. It is designed to safeguard the health of each person. It is performed by a physician. There are several reasons why individuals should have physical examinations at regular intervals.

Examinations for Protection from Disease. The first reason for the health examination is to secure protection against those diseases for which reliable vaccination or immunization materials are available. Many individuals have never been vaccinated against smallpox or diphtheria and typhoid fever. Medical science has developed standard techniques of saving life in this way. It is important to be vaccinated or immunized against communicable diseases. A health examination will help in this respect.

Another reason for the health examination is to discover early evidence of disease and other conditions that are not normal. Many children and adults are handicapped by illness. In some instances these handicaps could have been prevented by proper health protection and treatment in early life. When discovered early, many handicaps and serious effects of illness can be prevented. They can be discovered by having a health examination.

Examinations to Discover Defects. A third reason for the health examination is to discover physical defects and deformities. Many people have some physical defect or deformity. Some are not aware of their condition. When discovered through the health examination, proper steps may be taken to correct or improve the conditions.

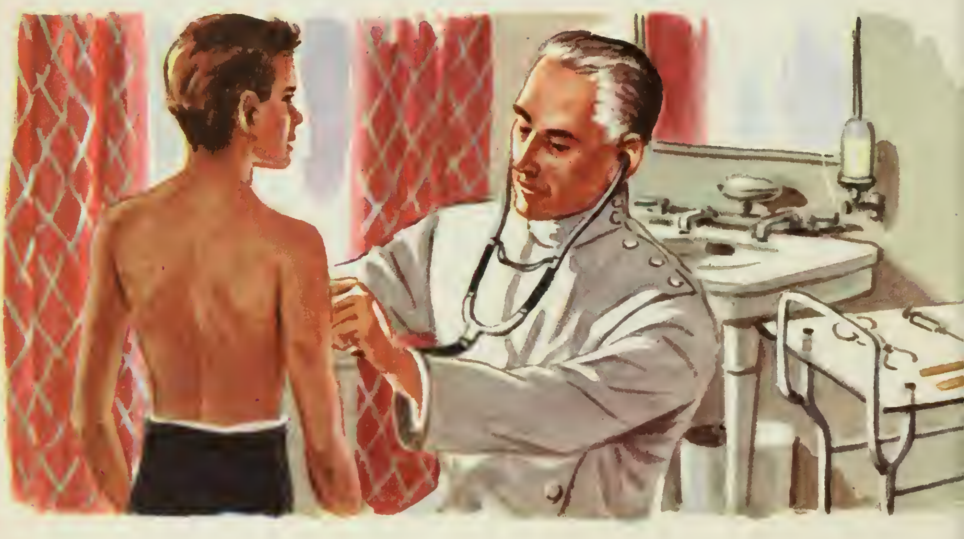
A fourth reason for the health examination is to discover faulty habits of living. Many persons go through life with poor habits of eating, resting, working, or playing. These faulty habits of living should be corrected before they have a chance to do damage. Every person should make an effort to improve himself. A good health examination will discover faulty habits of living when such habits exist.

Dental Supervision. Everyone should keep himself under good dental supervision. A regular visit to the dentist is important. This should be done at least once a year, preferably every six months. Such visits will enable the dentist to find dental cavities and prevent tooth decay. In like manner, the same rules apply in the care of the entire body. Regular examinations will disclose the steps that should be taken to protect the health of the individual.

Content of the Health Examination

Health History. There are many important items that need to be considered in a health examination. Before the physician gives the examination, he needs to have a complete health history record of the individual. This is used as a background for the physician's examination. The information on the health history record is supplied by the child and his parents.

(1) Identification of pupil by name, address, parentage, date of birth, sex, race, and school grade.



(2) List of occurrence and dates of diseases, operations, injuries, immunizations, and tests for contagious diseases.

(3) Measures of height and weight, taken at regular intervals. (Sometimes other body measurements are recorded.)

(4) Observations about the vision and hearing.

(5) Presence of any symptoms of illness at the time of examination.

Method of Examination. The physician usually gives the examination in the following order.

(1) He observes your size, shape, and posture.

(2) He judges your condition of nutrition including the color and texture of the skin, the condition of the hair, the muscle size and firmness, and the amount of fat tissue.

(3) He examines your eyes, and their movements. Vision tests with the eye chart are usually done before the examination begins.

(4) He examines your ears by looking into the canal with a lighted instrument to see the condition of the eardrums. Hearing tests may be done by whispered voice, by watch ticking, or by a special instrument called an audiometer.

(5) He examines your lips, mouth, teeth, throat, and tonsils. He inspects your nose for discharge or evidence of mouth breathing.

(6) He examines your neck glands or lymph nodes to determine their presence, size, and number. This tells the physician a great deal about the condition of the tonsils and adenoids. He also feels the thyroid gland for the pressure of a goiter.

(7) He examines your lungs by tapping your chest, and by listening with the stethoscope.

(8) He usually examines your heart at the same time by tapping for size, listening to the sounds, and counting the heart rate. A more detailed examination may be done if there is any suggestion of heart trouble.

(9) He feels the abdomen for the various organs and for any unusual lumps.

(10) He studies your arms and legs and the movements and strength of muscles. He also studies your feet and hands.

(11) He studies carefully any unusual findings which may be discovered.

Your Health Record. All of this information is noted on your individual health record. This is the physician's record of your growth and development. It tells your story and becomes more and more valuable as you grow older.

Making Use of Health Records. The health examination is of little value unless the findings are used. The physician or nurse interprets the findings to the parents for it is their responsibility to keep children in the best possible physical condition.

If the results of physical examination indicate a fine state of health, you are proud of your record and resolve to continue to follow the health rules. When conditions are found which may be improved, they should be corrected at once. This will make the health examination a worth-while experience.

A Healthful School Environment

School Health Examinations. Health examinations are given to the pupils in many schools. The schools and the community realize the value of healthy children and may provide these services for all the children. These services include the physical examination and the consultation with your parents. In this way your parents learn about any conditions which should be corrected. They also find out about any additional health measures which should be taken. Physicians, nurses, dentists, and dental hygienists from the health department or from the school staff conduct these examinations. Frequent vision tests are made because in growing children the ability to see clearly may change in a year or two. Hearing tests may be made individually or in groups in certain grades. In addition to looking after the health of the children, these health people are interested in maintaining a healthful school environment.

Building and Grounds. A school site should be selected with great care to provide for a healthful environment. The school building should be located on a site that is well drained, free from noise, away from traffic hazards, easily accessible, and has plenty of space for play. It should also be near a good water supply. Attractive surroundings, such as trees and shrubs, are very desirable.

Most states have rules and regulations which must be followed when the school building is constructed. Fireproof materials are used in the construction. As a result of serious school building fires in the past, laws have been passed which require fireproof construction. All doors must open outward on automatic safety latches. Certain standards must be met regarding sanitation, heating, ventilation, lighting, and many other things to protect your health and safety.

Sanitation. School buildings should be kept clean and sanitary. The school custodian plays a very important part in the sanitation of your school building. Floors are swept regularly with a sweeping compound. This prevents dust from rising and gives the floors a bright, shiny look. Hallways, classrooms, lunchrooms, and all parts of the building and grounds are kept clean to protect the pupils.

Washbowls and soap and water are provided for you to wash your hands after going to the toilet. Toilet seats are disinfected at regular intervals. Sanitary drinking fountains are installed for your use.

The pupils should help to keep the buildings and grounds clean. All papers and refuse should be placed in containers provided for that purpose. Pupils should take pride in a clean, sanitary building.

Heating and Ventilation. Proper heating and ventilation also protect your health. Classrooms should not be overheated. The temperature of classrooms should be between 68 and 72 degrees, F. Pupils cannot do their best work in an overheated classroom. Pupils may also catch colds more easily when the classroom is overheated.

Ventilation of the classroom is important. The comfort of people in a room depends on air changes. In warm weather this is taken care of by natural means, open windows and doors. In the wintertime we must depend on mechanical systems installed in the building. Movement of air in a room is necessary for your comfort. Air changes and movement of air take care of evaporation of perspiration from the body, and remove objectionable odors. Humidity is also an important factor. Having potted plants in the classroom helps to add moisture in the air.

Lighting and Sight. Good lighting in the classroom and the home is important to the eyes. The eye is like a camera. It has the ability to adjust to many lighting conditions.

The iris is a self-adjusting diaphragm opening. The pupil admits light. The lens in the eye, like the lens of a camera, bends the light rays so that they come to focus on the retina. The retina is like the film used in a camera. The inside of the eye is dark as in a camera. The image on the retina, as on a film, is upside down.

It is necessary to have the right amount of light when you study. Inadequate light will cause the eyes to tire, and will result in eyestrain. Bad lighting conditions that interfere with clear vision cause eyestrain and make a person's work more difficult. The amount of light you need depends on the work you are doing. For fine work, such as locating sites on a map or putting together parts of a watch, you require more light than you do for reading.

School authorities should do many things to protect your eyesight. Classrooms should have plenty of windows to admit light. Window shades should be kept in repair so as not to shut out light. Ceilings and walls should be painted in light colors to reflect light. Your desks and chairs should be arranged to admit light over your left shoulder. Efforts should be made to eliminate glare from glossy surfaces. Attention to all these items will help prevent fatigue of the eyes.

The Work of the Health Department

The Staff. The City or County Health Department provides many health services. These services are for the protection of all the people who live in the community. In addition to the physicians, nurses, and dentists, there may be the sanitary engineers, the food and drug inspectors, laboratory services, the health educator, and others.

Communicable Disease Control. When someone has a communicable disease, the doctor must report it to the health department. The health department then places a quarantine sign on the house. This warns other people that someone has a disease that can be passed from person to person. A quarantine means that no one is allowed to enter or leave the house unless he has been vaccinated or immunized for the disease. The quarantine sign is taken down after the danger period is past. The danger period varies for different diseases.

Inspection by the Health Department. The sanitary engineers inspect the water supply to make sure it is safe to use. Health departments make laboratory tests of well water for harmful bacteria. The health department then places a tag or sign on the well which states whether or not the water is safe for drinking. The next time you stop for a drink in the country at a well, look for signs posted by the health department. They are usually posted wherever the water supply is safe. When there is no sign, you had better wait and get safe water somewhere else.

Restaurants are inspected and checked on their cleanliness. Public eating places must follow many health rules before they are permitted to sell food to the public. They must have a clean, sanitary restaurant. They must use safe water. They must dispose of garbage properly. They must do these things and many more. In some states all food handlers in public eating places must have health examinations. This is to make sure they have no diseases that can be passed on to other people.

Health departments inspect dairies to make certain that clean, safe milk is being provided. They also inspect the dairy farms from which the milk comes. The cows are tested for tuberculosis and other animal diseases. The meat and milk the public buys must be safe for consumption.

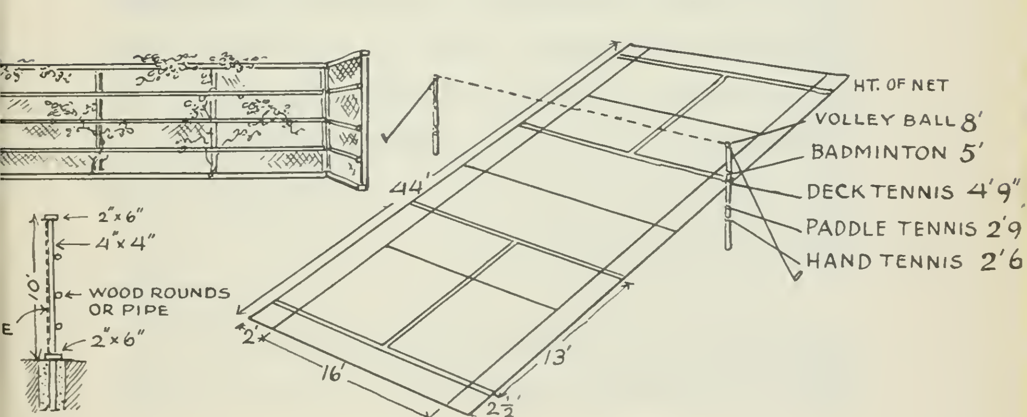
By Ewing Galloway, N. Y.

A Health Department milk inspector taking samples from milk cans on a railroad platform.

In addition to these many services, health departments keep records of all births and deaths. They carry on a program of public health education. The work of the health department safeguards the health and safety of the people.

Activities for Health

Backyard Olympics. Many good games can be played on one combination court. You have learned what a single court is. But this combination court is one on which five different games can be played. The combination court does not require too much space. The five games are good for small spaces and two or more players may play any or all of them.



Put some lime or white flour in an old coffee pot. Mix it with water and pour it through the spout. Mark the boundaries of the court so that the white lime marks can be seen clearly.

Tennis. Hand, deck, and paddle tennis can be played with an old or a new tennis ball or a soft rubber ball about the size of a tennis ball. Look at the diagram for the picture and the dimensions of each court all wrapped up in one combination package. Your backstop can be built attractively. Your mother and you can plant some vines on the trellis which can serve as a backstop to prevent balls from interfering with a neighbor's property.

Volley Ball. If there are more companions available, volley ball can be played on the combination court. Study the diagram carefully. Volley ball skills can be practiced using the same net. Each game requires a different height to the net.

Badminton. This game, which resembles poona, was named for the castle of an English duke who liked to play the game.

A shuttlecock is used in badminton instead of a tennis ball. It is lighter and some players call it the "bird" because it is made of cork with feathers stuck in it. The feathers all point in one direction. A sponge or a ball of yarn makes a satisfactory substitute for the "bird." The sponge should be 3 inches in diameter. The ball of yarn could be 2½ inches in diameter, firm, but not hard.

The racket has a long handle and is strung with catgut like your American tennis racket. A good substitute for a racket may be made of 3-ply material with a round head 6 inches in diameter and a 10-inch handle.

It is fun to see how many times one player can bat the shuttlecock or bird into the air and keep it off the ground. It is more fun to play with one, two, or three other persons. The real game requires a small net and slender posts, but it can be played without either. Instead, a clothesline or twine may be stretched between trees, posts, or two buildings. The rules are much like your tennis rules, but badminton is an easier game for boys and girls to learn. It is a good game to play until you are older and stronger. Then you will be ready to learn to play tennis.

The one who starts the game is called the server. The server stands in the right-hand half of the court and serves or tries to hit the bird with an underhand stroke to the player in the opposite right-hand court. If the player who serves wins the point, he serves the next time from the left-hand court and into the opposite left-hand court. He continues to change over from the right to the left as long as the serving side scores. Fifteen or twenty-one points scored make a game.

It is important to be fast on your feet, to be agile. Your foot and leg muscles, as well as your arm and hand muscles, must be well developed and strong in order to play this game well.

Playing in the backyard will provide you and your companions with fun. You will learn how to play with others. You will be learning first lessons in the skills of many sports. When you are older, you may excel in one of these sports and continue to enjoy it the rest of your life.

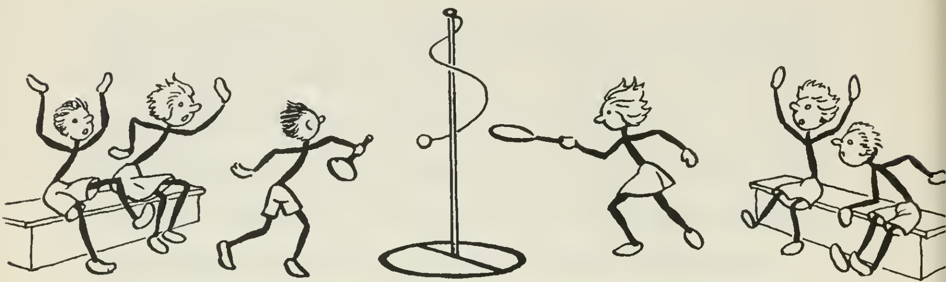
Tether Ball. The game of tether ball came to us from England. It originated there fifty years ago. It is closely related to tennis. It can be played in a small space. The equipment may be bought or can be made. One, two, or more players can play. Usually, it is played in the yard or on the playground, although good practical substitute equipment can be used in the gymnasium or playroom.

You won't find a more lively game than tether ball. The word tether means to tie, or confine with a rope. A space only twenty feet in width is needed.

An upright pole is erected and set deeply in the ground, and packed well to avoid vibration. A strong cord seven and one half feet long is tied securely to the top of the pole. A ball is attached to the other end of the cord. An old tennis ball may be used, or a soft ball made of yarn. Players try to wind the line or cord around the pole in opposing directions. If tennis rackets or wooden paddles are not available, hit the ball with the open hand. The ball used must be soft if a tennis racket or the hand is used to strike it. A jumping standard may be used indoors for a substitute pole.

Here are the rules to follow for one player on a side.

1. Toss for the first turn at serving the ball.
2. Mark a white spot high on the pole.
3. The player who starts to serve has his choice of direction to wind the cord around the pole.
4. Mark a serving spot on the three-foot circle.



5. The player who starts the serve stands on the serving spot and starts the game. If he does not hit the ball the first time, the other player is given his turn to serve.

Then the fun begins. Each player knows the direction he is to wind the cord around the pole, and each hits the ball as often as he can.

6. Players must stay on their own side of the twenty-foot line and outside the circle when striking the ball.

The game is won by the player who succeeds in winding the cord around the pole. To complete the winding the ball must be above the white spot marked on the pole. Try making your own equipment for this interesting game. You will enjoy playing the game with your companions. It can be played by two players or by teams of players.

Things to Remember

1. Good health habits mean actually doing the things you say should be done about health.
2. The health department inspects food and milk to protect your health.
3. The health department inspects the water supply and sees to the proper disposal of garbage and sewage.
4. The health department is responsible for the control of communicable diseases.
5. The work of the health department protects the health and safety of the people in a community.
6. The health examination is planned to protect your health.
7. Health examinations help to discover early evidence of disease.
8. Health examinations help to protect you against those diseases for which reliable vaccination or immunization materials can be had.
9. Health examinations help to discover physical defects and deformities.
10. Health examinations help to discover faulty habits of living.
11. Before the physician gives the examination, he needs to have a complete health history record of the individual.
12. A healthful school environment is important to protect your health.
13. Most states have rules and regulations which must be followed when a school building is constructed.
14. School buildings should be kept clean and sanitary.
15. Proper heating, ventilation, and humidity are important factors in the protection of your health.

16. Bad lighting conditions cause eyestrain.

Study Exercises and Questions

1. Make a list of community activities that add to your comfort and protection.
2. How are community health activities planned and provided, and who is responsible for them?
3. Give four reasons why individuals should have physical or health examinations.
4. Why is a health history record important to the physician at the time of a health examination?
5. List five things that should be considered when selecting a school site.
6. In what ways does the school custodian protect the health and safety of school children?
7. What conditions should be given consideration for good lighting in the classroom?
8. What is ventilation?

Suggested Activities

1. Find out what the Snellen Eye Test is, and be ready to tell the class about it.
2. Visit the nearest city or county health department. Obtain detailed information on personnel, administration, and kinds of services rendered. Be prepared to report your findings to the class.

Words to Master

custodian	deformities	stethoscope
environment	lymph nodes	symptoms
nutritional	utility	quarantine

GLOSSARY

Acid—A substance, sour to taste, which dissolves in water. In chemical tests acids turn blue litmus paper red.

Adenoids—Growths of flesh in the throat behind the nostrils.

Administration—The act of managing affairs.

Aerobic—Said of bacteria which require oxygen.

Agar-agar—A jelly-like substance obtained from seaweeds. It is used as a food for the cultivation of bacteria.

Alcohol—The liquid obtained when fermented grains and potatoes are distilled. Alcohol is useful as an antiseptic.

Alert—Active; watchful; wide-awake.

Ammonia—A solution in water of a gas obtained by distilling organic bodies containing nitrogen.

Anaerobic—Said of bacteria which can live without free oxygen.

Analysis—The process of resolving a compound or problem into parts or elements.

Anthrax—A contagious disease, attended by fever, of human beings and animals.

Antidote—Something that hinders or removes the effects of poison or disease.

Antiseptic—A solution which will hinder or prevent decay or decomposition.

Antitoxin—A substance produced in living tissues of plant or animal, to check or hinder or make neutral a bacterial poison that produced it.

Apparatus—The equipment, tools, device, or appliance by which a process of work or play is carried on.

Appetite—A desire or strong liking for food or drink.

Artificial—That which is produced by art or adaptation rather than by nature.

Audiometer—An instrument by which hearing is tested.

Automatically—The manner of moving or acting without being controlled by the will.

Bacteria—A group of plant organisms, some harmful, some helpful, too small to be seen without a microscope.

Balance—The state of being steady so as not to tip or fall over.

Basic—Pertaining to a base; fundamental.

Blanching—The process of plunging food first into hot and then into cold water.

Blood vessels—The tubes and channels through which blood flows in the body.

Caffeine—The stimulant found in coffee and tea.

Calcium—A soft metal, silver white in color. A mineral necessary to the growth of teeth and bones.

Carbohydrates—Chemical compounds composed of carbon, hydrogen, and oxygen; sugars and starches.

Carbon dioxide—A gas formed by burning fuels and the decay of living matter.

Cells—The smallest unit of the substance of which animals and plants are made.

Characteristics—Qualities, traits, or features that distinguish persons, places, and things.

Chemical—A substance obtained when two or more substances act upon one another to cause permanent change.

Chlorine—A heavy poisonous gas used in liquid form as a disinfectant.

Chlorophyll—Green coloring matter in plants.

Citrus—Relating to the orange, lemon, lime, and citron.

Communicable—That which can be spread or communicated from person to person or place to place, as a disease.

Complex—Not simple; made of many parts.

Complicated—Difficult, complex, or involved.

Condensed—Reduced to a denser or more compact form.

Consultation—A council or interview in which advice or opinion is given.

Consumption—Using up or consuming anything, such as food, time, fuel, or other material.

Contagious—That which is communicable, catching, as a disease; can be spread from person to person.

Contaminate—To spoil or make impure by contact with waste matter or impurities.

Contract—To shrink; to draw up; to shorten and narrow.

Controlling—Having and using the power to govern or curb actions of persons, animals, or machines.

Curds—The solid or thickened part of milk.

Decay—Rot; decomposition; change from a sound state to a state of unsoundness.

Defects—Flaws; imperfections; conditions out of the ordinary.

Defenses—Means of protecting from harm or disease.

Deficiency—Something lacking for completeness.

Deformities—Irregulations or wrong formations of parts of the body.

Degerminated—That grain from which the germ has been removed.

Dehydration—The process of removing water from food and other substances; drying.

Dentin—The hard material of which the main part of the tooth is composed.

Destroying—The act of putting an end to, doing away with; killing.

Diaphragm—The partitions or walls of tissue, sinew, or muscle, for the purpose of separating and protecting adjoining parts in the body or in instruments.

Diet—The kind and amount of food and drink that a person or animal usually eats.

Digestion—The act or process of changing food that has been eaten into a form in which it can be used by the body.

Disease—An illness or weakened condition of health caused by bacteria.

Disinfectant—Something that destroys bacteria.

Disposal—Distribution; arrangement; giving or getting rid of.

Disposition—The natural attitude one has toward persons and things.

Effect—A state of affairs or condition produced by a cause.

Element—A part; that which cannot be detected or separated without chemical or mental analysis.

Elimination—The act of getting rid of, removing, expelling.

Enamel—The hard, white, outer covering of the crowns of the teeth.

Endurance—The state of lasting; the ability to bear hardship.

Enriched—Made richer in quality, as of flavor, nourishment, or color; added to.

Environment—The surrounding conditions and forces that influence and affect the development and growth of persons, animals, and places.

Essential—Distinctive; fundamental; important; necessary.

Evaporation—The process through which moisture is lost from a substance in the form of vapor.

Expectorate—To spit.

Experimented—Made tests to prove or find out something.

Factors—Circumstances, elements, or influences which help to produce a result.

Fahrenheit—A kind of thermometer on which the boiling point is at 212° and the frezing point is at 32°.

Famine—A shortage or complete lack of something, such as food or fuel.

Fatigue—Tiredness or weariness.

Fats—Greasy or oily substances of the body. Also oils and parts of meat or other foods that yield oils and grease.

Fermentation—The chemical change which causes milk to sour, apple juice to turn to vinegar, and starches to turn to sugars.

Fertile—Capable of growing, producing fruit or vegetation.

Fertilizer—That which supplies nourishment for plants.

Film—A thin layer of skin or membrane.

Focus—To bring to a central point. The point at which light rays meet after passing through a lens.

Fortified—Made stronger or richer in quality.

Functions—The purposes or kinds of work which certain objects or mechanisms are equipped to fulfill or perform.

Glands—Small organs in the body which produce different substances to be used by or discharged from the body.

Goiter—A swelling or enlargement of the thyroid gland in the throat.

Graduated—Arranged or divided into degrees, grades, or progressive parts.

Graph—A diagram which shows relationships between things.

Handicap—A disadvantage which interferes with progress.

Hazards—Dangers; perils; risks.

Homogenized—Blended or mixed by force into one part, as homogenized milk in which the butter fat and whey are blended to the point at which they will not separate.

Humidity—Dampness and moisture of the atmosphere.

Hunger—A strong desire which indicates the need for food.

Hygienists—Persons who study about and instruct in the care of health.

Immunization—The state of being immune or protected from a disease.

Industry—A branch of manufacturing or general business.

Infection—A condition or disease caused by contact with certain harmful bacteria.

Inspection—Close examination to judge quality or detect impurities.

Instruments—Appliances or contrivances by which something is done.

Internal—Being inside; having to do with inside organs or affairs.

Invasions—Forcible attacks or entrances by enemy or pest.

Invisible—That which cannot be seen.

Iodized—Having had iodine added.

Iris—The colored part of the eye around the pupil.

Iron—A metal that rusts easily and is strongly attracted by magnets; a mineral important to the body.

Irradiated—Treated with rays of light.

Laboratory—The room or building in which scientific projects and tests are carried on.

Larva—The form in which most insects hatch from the egg, wingless and sometimes wormlike.

Legumes—Vegetables that have pods, such as peas and beans.

Lens—The part of the eye, glasses, or camera, that focuses light to form clear images.

Locomotion—The act or power of moving. A means of getting from place to place.

Maggots—Wormlike larvae of an insect.

Magnesium—A light, easily worked metal; a mineral of the body.

Magnifying—Increasing in size; making larger.

Maintenance—The upkeep, feeding, or support of the body or property.

Maximum—The highest point or greatest amount allowed.

Mechanical—Produced or worked by machinery; not made or operated by hand.

Membrane—A thin, soft layer of tissue in the body of an animal or plant.

Microscope—An instrument equipped with a lens that enlarges images of objects and makes it possible for a person to see objects that are invisible to the naked eye.

Minerals—Elements of substance; neither animal nor plant, nor dead matter in another form.

Minute—Extremely small; petty.

Muscular—Pertaining to muscles; having many or large muscles; strong.

Narcotic—A drug that eases pain and causes sleep.

Natural—As provided by nature; not acquired; not made by man.

Nicotine—The drug contained in tobacco.

Nitrates—A class of soluble crystalline salts or esters of metals.

Nutrition—Nourishment; food; the act or process of absorbing food or nourishment.

Opponent—One who is on the opposite side or team in a game, contest, debate, or controversy; one who opposes.

Organisms—Any living beings.

Parentage—Ancestors, parents.

Particles—Small bits or portions.

Peptone—A substance into which protein foods are changed in the stomach by the action of pepsin in the gastric juice.

Petri dish—A small, shallow, glass dish with a loosely fitting lid, used in experiments with bacteria.

Phosphorus—One of the minerals found in and necessary to the health of teeth and bones.

Poison—A substance which can injure or kill a living organism if taken into the body.

Posture—The position of the body while walking, standing, and sitting.

Potassium—One of the minerals necessary to maintain good health.

Protein—A nourishing food element, important to all living cells, animal or plant.

Pupa—The cocoon or case stage in the development of an insect; the stage which follows the larva.

Purified—Made pure and safe to use.

Quarantine—A method to prevent persons with contagious diseases from moving among other persons and spreading the diseases.

Refrigeration—The process of making and keeping food materials cold.

Refuse—Waste material; garbage; rubbish.

Relationship—The condition of affairs existing between persons or things living or working together or having dealings with one another.

Relaxation—The act of lessening tenseness; recreation or rest.

Resistance—The act of standing up against, opposing, or preventing.

Respiratory tract—The system of organs used for breathing.

Responsibility—The quality of being reliable, dependable, or trustworthy.

Restore—To renew or bring back to a certain condition.

Retarding—Delaying the progress of; making slow; hindering.

Retina—The membrane lining of the back part of the eyeball; the part of the eye that receives images of vision.

Saboteurs—Those persons or things which destroy for the sake of injuring someone or something.

Safeguard—That which protects and gives safety; a defense or protection against disease.

Saliva—The natural fluid that forms in the mouth; fluid produced by salivary glands.

Sanitary—Clean and free from dirt and filth; protecting from disease.

Sauerkraut—Cabbage that has been cut fine, salted, and allowed to ferment.

Scavenger—One who or that which cleans up dirt and filth.

Scientific—Pertaining to science; making use of facts of science.

Secretions—Substances prepared by parts of the body.

Sensation—The feeling or experience caused by action of the sense organs.

Stagnant—Having become dirty and impure from standing still, as of air and water.

Stamina—Strength; vigor; the ability to endure.

Sterilizing—Making free from bacteria.

Stethoscope—An instrument used in examination of a person's chest to convey sounds.

Stimulate—To excite; to rouse to action.

Structure—The act or manner of building; the arrangement of parts and particles, or organs and their elements and tissues into substance, or a body.

Supervision—The act of directing work or activity.

Symptoms—Signs or indications of a disease or illness.

Synthetic—Not of natural growth or development; made artificially; made of artificial products.

System—A set of organs or parts forming a whole; a plan or method of organization.

Taste buds—The small, budlike end organs of taste.

Technique—Expert method of performance; skill.

Temperature—Degree or amount of heat or cold of a body, of air, or of water, measured by a thermometer.

Thermometer—An instrument for measuring temperature.

Thermos bottle—A kind of vacuum bottle in which substance and liquid may be kept for some time at the temperature at which it was put into the bottle.

Thyroid—Pertaining to the large gland which lies near the throat in human beings.

Tissue — The cells and substance around them from which animal and plant bodies grow.

Toxins—Poisons produced by chemical changes in animal and plant tissue which act as antidotes.

Tubers—Potatoes or other similar underground vegetable structures.

Ultraviolet—Said of rays that have shorter wave length than any rays that are visible; the rays that have certain healing qualities.

Units—Standard definite amounts or individuals used as the basis for measurements.

Vaccination—The act of injecting bacteria into the blood of a person to make him safe from an attack of smallpox.

Vacuum—An enclosed empty space from which most of the air has been removed.

Ventilation—The process of bringing in fresh air and removing stale air in a room; setting up circulation of fresh air.

Vigor—Energy, power, or strength of body or mind.

Visible—Said of anything that is capable of being seen by the naked eye.

Vital—Essential or very important to life; having the qualities of living bodies.

Vitamins—Elements found in many foods that are important and necessary to the physical development of man, animals, and plants.

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